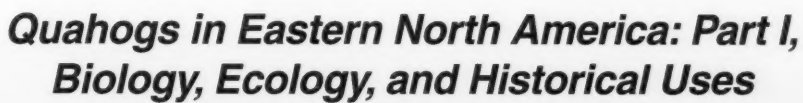




United States Department of Commerce



# Marine Fisheries REVIEW

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On the cover:  
A montage of photographs from this quahog paper surrounding the Warwick, Rhode Island, statue by Antonio Tobias Menzies commemorating the importance of the quahog fishery to that state. The images show quahogs being harvested and cooked, as well as being made into shell artifacts and worn as decorative garments.



Articles

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America: Part I, Biology,  
Ecology, and Historical Uses

Clyde L. MacKenzie, Jr., Allan Morrison, David L. Taylor,  
Victor G. Burrell, Jr., William S. Arnold, and  
Armando T. Wakida-Kusunoki

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# Quahogs in Eastern North America: Part I, Biology, Ecology, and Historical Uses

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## Introduction

The quahog, *Mercenaria* spp., ranging from the Canadian Maritimes to Mexico's southern State of Campeche, has long provided North Americans with

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**ABSTRACT**—The northern quahog, *Mercenaria mercenaria*, ranges along the Atlantic Coast of North America from the Canadian Maritimes to Florida, while the southern quahog, *M. campechiensis*, ranges mostly from Florida to southern Mexico. The northern quahog was fished by native North Americans during prehistoric periods. They used the meats as food and the shells as scrapers and as utensils. The European colonists copied the Indians treading method, and they also used

a high quality food and has also been an important part of the seafood trade and sociocultural customs. Officially, the common name "northern quahog" is listed for *Mercenaria mercenaria*, which ranges from New Brunswick, Canada, into Florida, while "southern quahog" is given for *Mercenaria campechiensis*, ranging mainly from Florida to southeastern Mexico (Turgeon et al., 1998). But in the industry, the term quahog is used from the Canadian Maritimes through Rhode Island, while simply clam or hard clam is used from Connecticut through Texas; in Mexico, it is the almeja (clam).

Through the centuries, the Native Americans harvested quahogs for food

and used their shells as tools and utensils. In colonial times, the natives made unique shell beads called wampum, which was used as personal ornaments and, when strung, used to cement treaties, and it was also used by the colonists as currency. Wampum was traded widely and used in the fur trade with the western tribes. The quahog became part of the New England and New York cultural tradition of the clambake (Neustadt, 1992), and Robinson (1981) speculates that "clam chowder" may have been the first American soup. Quahogs have thus been part of a long American culinary and also marketing traditions, which included selling them alongside oysters,

short rakes for harvesting quahogs. The Indians of southern New England made wampum from quahog shells, used it for ornaments and sold it to the colonists, who, in turn, traded it to other Indians for furs. During the late 1600's, 1700's, and 1800's, wampum was made in small factories for eventual trading with Indians farther west for furs.

The quahogging industry has provided people in many coastal communities with a means of earning a livelihood and has provided consumers with a tasty, wholesome food whether eaten raw, steamed, cooked in chowders, or as stuffed quahogs. More than a dozen methods and types of gear have been used in the last two centuries for harvesting quahogs. They include treading and using various types of rakes and dredges, both of which have undergone continuous improvements in design. Modern dredges are equipped with hydraulic jets and one type has an escalator to bring the quahogs continuously to the boats. In the early 1900's, most provinces and states established regulations to conserve and

maximize yields of their quahog stocks. They include a minimum size, now almost universally a 38-mm shell width, and can include gear limitations and daily quotas.

The United States produces far more quahogs than either Canada or Mexico. The leading producer in Canada is Prince Edward Island. In the United States, New York, New Jersey, and Rhode Island lead in quahog production in the north, while Virginia and North Carolina lead in the south. Connecticut and Florida were large producers in the 1990's. The State of Campeche leads in Mexican production. In the northeastern United States, the bays with large openings, and thus large exchanges of bay waters with ocean waters, have much larger stocks of quahogs and fisheries than bays with small openings and water exchanges.

Quahog stocks in certified beds have been enhanced by transplanting stocks to them from stocks in uncertified waters and by planting seed grown in hatcheries, which grew in number from Massachusetts to Florida in the 1980's and 1990's.

fish, and other foods and goods on street stands and push carts in eastern cities in the 1800's and continuing through the 1930's.

For many decades, the quahog trade was limited, though important locally, but in the 1880's it began to expand mainly owing to railroad transportation. During 1885, a recorded quantity of 4,000 metric tons (t) of northern quahog meats were landed in the eastern United States, 2,000 t were landed in 1924, and 6,000 t were landed in 1960 (Lyles, 1969). During 1997, about 100 t of northern quahog meats (23,000 bu) valued at \$1 million were landed in eastern Canada, while 5,300 t of meats (1,180,000 bu) of northern and southern quahogs valued at \$54 million were landed in the eastern United States. In the 1990's, about 5,000 fishermen were active daily harvesting northern quahogs during the summer, but trivial quantities of southern quahogs were landed in the States of Texas through Alabama in the U.S. Gulf of Mexico (MacKenzie and Burrell, 1997). Landings of southern quahogs in Mexico are believed to be smaller than those in Canada, but specific landings data are scarce.

This article (part I) reviews the range, biology, and ecology of quahogs, gives an historical overview of the industry (including wampum manufacture and usage and the use of quahogs in clambakes), and describes harvesting gears and methods. Part II summarizes the history of the industry in specific Canadian provinces and U.S. and Mexican states (including trips with typical quahoggers and wardens) and discusses quahog enhancement programs. The authors have been professional observers of quahogs and the quahog fishery for many years. A substantial amount of the text material is based upon these observations and is unannotated. The remaining material is collected from the literature and is so cited.

### Quahog Distribution, Biology, and Ecology

#### Geographic Range

Quahogs inhabit broad, mostly level bottoms of estuaries, bays, and sounds, where salinities exceed 15‰, and a few

oceanic areas fairly close to shore. They usually live burrowed within 1–2 cm of the surface in sand, muddy sand, and mud-like sediments. Ingersoll's (1887: 595–596) summary of the range and distribution of the northern quahog remains accurate in light of today's knowledge: "The quahog is very abundant along the coast from Cape Cod to Florida. North of Cape Cod, it is comparatively rare and boreal. It does not occur on the coast of Maine or in the Bay of Fundy, except in a few special localities, in small, sheltered bays, where the water is shallow and warm.... but in the southern parts of the Gulf of St. Lawrence, as about Prince Edward Island and the opposite coast of Nova Scotia, where the water is shallow and much warmer than on the coast of Maine, this species again occurs in some abundance, associated with the oyster.... and constitutes here a genuine southern colony, surrounded on all sides, both north and south, by the boreal fauna." More recently, Dillon and Manzi (1989) have clarified the northern quahog ranges from New Brunswick, Canada, to the central coast of eastern Florida, and a subspecies, *M. mercenaria texana*, occurs in low abundance in the northern Gulf of Mexico. The northernmost location where northern quahogs have been harvested commercially is Neguac Bay in New Brunswick.

The southern quahog is common only on both coasts of southern Florida, but not the extreme southern tip around the keys, and is common in only a few small places in Mexico (Dillon and Manzi, 1989). It has been found in deeper offshore waters, usually in low abundance, as far north as Cape May, N.J. (Merrill and Ropes, 1967). Between North Carolina and Florida, northern and southern quahogs can cross-breed (Dillon and Manzi, 1989; Bert et al., 1993). Pure genotypes of *M. mercenaria* and *M. campechiensis* are found with some hybrids of the two species. In the Indian River Lagoon, Fla., in the mid 1980's, Arnold et al. (1996) found 67.9% were *M. mercenaria*, 4.4% were *M. campechiensis*, and 27.7% were hybrids of the two. The furthest area to the southeast where southern quahogs are harvested, albeit on a tiny scale, is Isla Arena, Campeche, Mexico (Fig. 1).

#### Biology

The shells of the two quahog species can be distinguished from one another by three criteria. The northern quahog has some purple nacre, while the southern quahog is white. The outside of the northern quahog shell is usually smooth, while the southern quahog shell usually has well-defined concentric ridges. The lunule in the southern quahog is at least as wide as high in the southern quahog, but is narrower in the northern quahog. In the few areas where the two species occur together, individuals with intermediate characteristics or mixed characteristics are found (Dillon and Manzi, 1989). The anatomical features of the shell and soft parts of the northern quahog are shown in Figures 2, 3, and 4. Some southern quahogs are pictured in Figure 5.

The life cycle of quahogs, including spawning, larval development, and settlement, is depicted in Figure 6, and the life history attributes of the northern quahog are summarized in Table 1. Northern quahogs spawn from spring to fall. The spawning period extends for at least 6 months in Florida but is shorter in more northern states and Canada (Stanley and DeWitt, 1983). Not all quahogs in a bed spawn at the same time (Loosanoff, 1937). Water temperature determines the maturation of gametes and helps to stimulate spawning. The males spawn first; their sperm contains a pheromone and when females take in some of the sperm the pheromone stimulates them to spawn their eggs (Nelson and Haskin, 1949). Fertilization occurs in the water. The estimated maximum production for one female during a single spawning season was 16.8 million eggs (Bricelj and Malouf, 1980).

The warmer the water, the less time it takes the fertilized eggs to develop into larvae and set. At a constant 18°C, larvae set from 18 to 24 days after fertilization, while at a constant 30°C, larvae set from 7 to 14 days after fertilization. Eggs held in water of 33°C show abnormal development and large mortality (Loosanoff et al., 1951). The salinity range in which eggs will develop is from 20 to 35‰, with the optimum around 27–28‰ (Davis, 1958). The eggs develop into



the straight hinge stage and the veliger stage follows. The final planktonic stage is termed the peliveliger, which has a foot and alternates between swimming and crawling on the bottom. After losing its velum, it crawls on the bottom and affixes itself to the sediment with a byssus. It soon drops the byssus and maintains itself beneath the sediment surface with its foot (Carriker, 1961).

Over its range, the northern quahog grows relatively slowly in the north and faster in more southerly areas. For example, growth from the settlement stage to market size takes at least 6 years in Prince Edward Island, Canada, and about 4 years in Maine, but only around 2 years in Georgia and Florida (Table 2). Growth is relatively rapid in the smallest sizes and slows as the quahogs grow (Jones et al., 1989) (Fig. 7). In Narragansett Bay, R.I., the principal growing season extends from about mid-April to mid-November (Jones et al., 1989), but most of this growth may occur by mid-July (Pratt, 1953; Pratt and Campbell, 1956). In contrast, in the southeastern U.S., northern quahogs grow fastest from December through March and slowest from June through November (Jones et al., 1990; Arnold et al., 1991). Quahog growth rates vary widely in different habitats of the same bay (Pratt and Campbell, 1956; Jones et al., 1989; Arnold et al., 1991). Northern quahogs become mature at a length of 22–33 millimeters. They release as many as 2.4 million eggs/yr when sublegal in length and many more as they grow. Northern quahogs are relatively hardy when compared with bay scallops, *Argopecten irradians*, and softshell clams, *Mya arenaria*, and can live as long as 46 years (Table 1). Northern quahogs are broadly distributed in bays and estuaries (Fig. 8, 9). Population density values for northern quahogs are listed in Table 3; typical densities (excluding juveniles) are from 5 to 20/m<sup>2</sup>.

### Predators

Quahogs are subject to predation from their larval stages to full size. Larval fishes (e.g. gobies, *Gobiosoma bosc*, and blennies, *Chasmodes bosquianus* and *Hypsoblennius hentzi*) feed on quahog veligers in Virginia (Harding, 1999), and Nelson



Figure 1.—The fishery for northern quahogs extends from Neguac, New Brunswick, to central Florida, while the range of southern quahogs extends from Cape May, N. J., to Isla Arena, Campeche.

Table 1.— Life history attributes of northern quahogs (compiled by Bricelj, 1993).

| Source:                                   |   |   |
|---|---|---|
| Longevity (yrs)                           | 40<br>46<br>36<br>23<br>1   | Jones et al., 1989<br>Peterson, 1986<br>Lutz and Haskin, 1985<br>Walker and Tenore, 1984<br>Belding, 1931 |
| Age at first sexual maturity (yrs)        | 1   |   |
| Length at first sexual maturity (mm)      | 22–26<br>33   | Eversole et al., 1980<br>Bricelj and Malouf, 1980   |
| Mean diameter of spawned eggs (µm)        | 67–81<br>81–82  | Bricelj and Malouf, 1980<br>Knaub and Eversole, 1988  |
| Fecundity (× 10 <sup>6</sup> eggs/quahog) | Mean<br>Sublegal<br>Littlenecks<br>Cherrystones<br>Chowders<br>Cherrystones and<br>Chowders | Maximum<br>2.4<br>7.9<br>16.8<br>16.2<br>29.9<br>37.3   |
|   | Littlenecks   | 1.9<br>3.3  |
|   |   | Calculated from Ansell, 1967<br>Calculated from Davis and Chanley, 1956<br>Knaub and Eversole, 1988       |

(1925) observed decreases in abundance of bivalve larvae coincident with large numbers of tentaculate ctenophores. Suspected predators of newly-set qua-

hogs, 0.25–0.50 mm long and, perhaps up to 1.0 mm, are the abundant shrimp. Laboratory observations by one of us (MacKenzie) showed specimens will eat

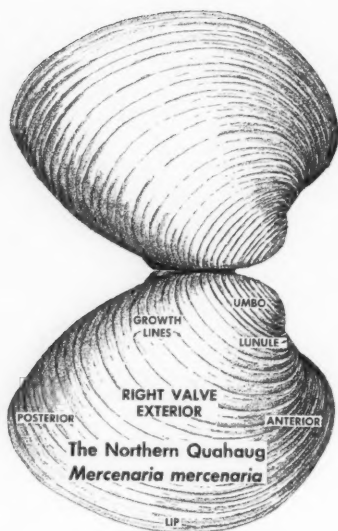


Figure 2.—The parts of the northern quahog shell (from Public Health Service, Bureau of Disease Prevention and Environmental Control, Northeast Shellfish Sanitation Research Center, Narragansett, R.I. 02882).

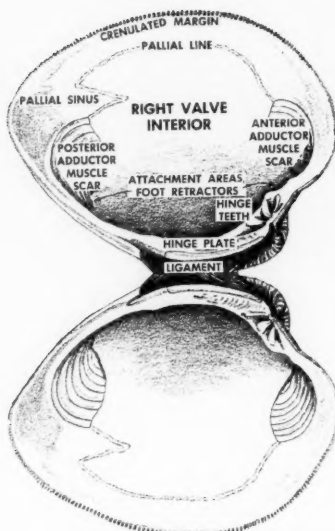


Figure 3.—The parts of the northern quahog shell (interior) (from Public Health Service, Bureau of Disease Prevention and Environmental Control, Northeast Shellfish Sanitation Research Center, Narragansett, R.I. 02882).

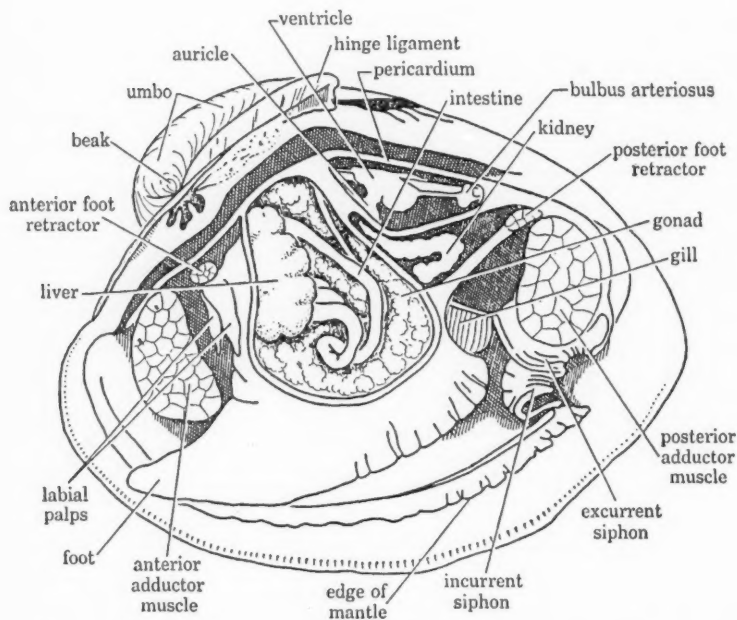


Figure 4.—The internal anatomy and part of the shell of the northern quahog (from Brown, Selected Invertebrate Types, 1950).

such post-set quahogs in finger bowls. Individual sevenspine bay shrimp, *Crangon septemspinosa*, ate at least 100 juvenile northern quahogs, at an age of 2–3 days after settlement, in sediment-free bowls within 24 hrs. Juvenile northern quahogs are eaten by many common predators, including various decapods and gastropods; starfish, *Asterias forbesi*; and such birds as brant, *Branta bernicla*.<sup>1</sup>

Predation is heaviest on the smallest sizes of quahogs (Fig. 10), and as quahogs grow, they become less susceptible to specific predators. The maximum quahog sizes which specific predator species can consume varies with the predator (Fig. 11). While predators such as hermit crabs, *Pagurus longicarpus*; spider crabs, *Libinia* sp.; and mud crabs, *Dyspanopeus sayi*, can consume only tiny quahogs, they are often numerous and in sediment-free finger bowls consume quahogs at a rapid rate.

The predator species occurring in quahog beds vary by locality, though shrimp may be numerous everywhere. In Connecticut, adult starfish; smooth whelks, *Busycotypus canaliculatus*; oyster drills, *Urosalpinx cinerea* and *Eupleura caudata*; xanthid mud crabs; rock crabs, *Cancer irroratus*; and hermit crabs, *Pagurus longicarpus*, have been numerous on quahog grounds and sometimes all have occurred together on the same grounds (MacKenzie, pers. observations). While scuba diving along the Connecticut coast, one of us (MacKenzie) has observed adult rock crabs apparently searching for quahogs at water depths of about 6 meters. The bottom sediments consisted of sand with some gravel and shell. The crabs were "walking" over the bottom searching for prey with the tips of their eight walking legs that penetrated the sediment surface. When a crab felt a solid object, it lifted it (usually a stone 1–1.5 cm across) to the surface with its legs, examined it by cradling it and turn-

<sup>1</sup>Nearly all observations made regarding predation on quahogs have related to adult rather than juvenile predators. We suspect the juvenile stages of some invertebrate predators which settle onto substrates, or in the case of oyster drills hatch from egg cases, simultaneously with settlement of juvenile quahogs may consume large numbers of them.

ing it over, and then dropped it. The crab then continued searching. When a crab found a quahog of about the same size as the stones (a rare occurrence), it crushed it (apparently not with its claws, but by forcing it against its carapace with its legs) and picked out the meats. One can see why crabs miss many quahogs when searching for them in sediments containing large quantities of stones or shells.

The grounds in Great South Bay, N. Y., have had whelks; oyster drills; mud crabs; lady crabs, *Ovalipes ocellatus*; rock crabs; blue crabs, *Callinectes sapidus*; and hermit crabs, but no persistent numbers of starfish. The coastal bays of Virginia have cow nose rays, *Rhinoptera bonasus*, and numerous blue crabs, besides some of the predators mentioned above; starfish are absent.

Herring gulls, *Larus argentatus*, commonly prey on northern quahogs, half grown to full size, along intertidal flats



Figure 5.—Southern quahogs, clams of the genus *Anadara*, and oysters, *Crassostrea virginica*, from Laguna Madre, Mexico. Photograph by C. L. MacKenzie, Jr.

during low tides. They carry them into the air, then drop them onto hard surfaces, such as paved roads, to break their shells and alight to pick out their meats.

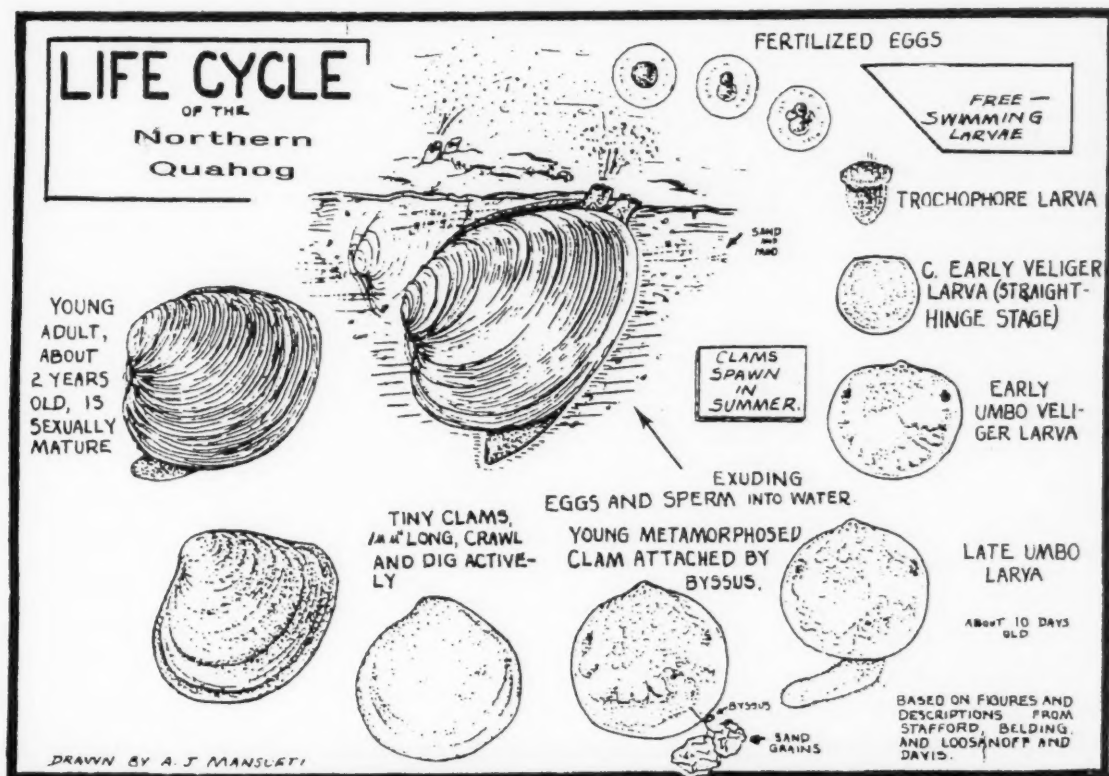


Figure 6.—Life cycle of the northern quahog (Drawn by A. J. Mansueti).

Table 2.—Average time (in years) to attain legal market size ( $\geq 48$  mm in shell length) of northern quahogs' natural populations along the species' latitudinal range, from north to south. Range is shown between brackets; unless indicated, time to market size is calculated from fitted von Bertalanffy, Gompertz or logarithmic growth equations (from Brice, 1993).

| Time (yrs) | Location                             | Source                        |
|------------|--------------------------------------|-------------------------------|
| 6.0        | Prince Edward Island, Can.           | Ansell, 1968                  |
| 4.4        | Maine                                | Ansell, 1968                  |
| 3.2        | Monomoy Point, Mass.                 | Ansell, 1968                  |
| 4.0        | Narragansett Bay, R.I.               | Jones et al., 1989            |
| 3.5        | Great South Bay, N.Y.                | Appendix 4 in Buckner, 1984   |
| (3.0–4.0)  |                                      |                               |
| (2.5–5.0)  |                                      | Greene, 1978                  |
| 3.0        | Barnegat Bay, N.J.                   | Kennish and Loveland, 1980    |
| 4.3        |                                      | From Table 5 in Kennish, 1980 |
| (3.8–4.6)  |                                      |                               |
| 4.4        | York River, Va.                      | Loesch and Haven, 1973        |
| 2.4        | Core Sound, N.C.                     | Peterson et al., 1983         |
| 2.0        | South Carolina                       | Eversole, 1987                |
| 3.0–4.0    | Wassaw Sound, Ga. (Intertidal)       | Walker and Tenore, 1984       |
| 2.0        | Kings Bay, southern Ga.              | Jones et al., 1990            |
| 2.2–2.3    | Indian River, Atlantic coast of Fla. | Jones et al., 1990            |
| 2.1        |                                      | Arnold et al., 1991           |
| (1.9–2.5)  |                                      |                               |
| 2.6        | Gulf Coast, Fla.                     | Ansell, 1968                  |

Table 3.—Densities reported for natural populations of northern quahog.

| Location           | Number/m <sup>2</sup> | Reference                   |
|--------------------|-----------------------|-----------------------------|
| Massachusetts      |                       |                             |
| Barnstable Harbor  | 1                     | Sanders et al., 1962        |
| Nantucket Sound    | 0.05–0.08             | Ropes and Martin, 1960      |
| Rhode Island       |                       |                             |
| Providence River   | 16.9                  | Ropes and Martin, 1960      |
| Narragansett Bay   | 4                     | Russell, 1972               |
| Greenwich Bay      | 2–12                  | Stickney and Stringer, 1957 |
| Greenwich Bay      | 215                   | Stringer, 1955              |
| Connecticut        |                       |                             |
| Long Island Sound  | 0.9                   | MacKenzie, 1977             |
| New York           |                       |                             |
| Northport Bay      | 6.5                   | MacKenzie, 1977             |
| Great South Bay    | 18.4                  | MacKenzie, 1977             |
| Islip              |                       | Buckner, 1984               |
| Open areas         | 16                    |                             |
| Closed areas       | 30                    |                             |
| Patchogue Bay      | 61                    | Greene, 1978                |
| East Patchogue Bay | 16                    | Greene, 1978                |
| Barret Beach       | 16                    | Greene, 1978                |
| East Islip         | 11                    | Greene, 1978                |
| Goose Creek        | 10                    | Kaplan et al., 1975         |
| New Jersey         |                       |                             |
| Raritan Bay        | 14                    | MacKenzie, 1977             |
| Raritan Bay        | 5–11                  | Campbell, 1967              |
| Little Egg Harbor  | 34                    | Carriker, 1961              |
| Maryland           |                       |                             |
| Chincoteague Bay   | 1 or 7.4 ?            | Wells, 1957                 |
| Virginia           |                       |                             |
| Poquoson Flats     | 5                     | Loesch and Haven, 1973      |
| North Carolina     |                       |                             |
| Johnson Creek      | 6.4                   | Peterson et al., 1983       |
| Back Sound         | 2–10                  | Peterson et al., 1984       |
| South Carolina     |                       |                             |
| Santee River       | 18–24                 | Rhodes et al., 1977         |
| North Inlet        | 6                     | Dame, 1979                  |
| Georgia            |                       |                             |
| Coastal            | 0.1–21                | Godwin, 1968                |
| Coastal            | 0–91                  | Walker and Rawson, 1965     |
| Wassaw Sound       | 0–100                 | Walker et al., 1980         |

Another predator which does not kill adult quahogs, but eats their siphons in the bays of southern Long Island, N.Y., and New Jersey is the winter flounder, *Pleuronectes americanus* (Kurtz, 1975; Festa, 1979; Scarlett, 1986, 1988; Scarlett and Guist, 1989). For example, in Rari-

tan Bay, N.Y./N.J., Steimle et al. (2000) found siphons of northern quahogs and surfclams, *Spisula solidissima*, were a dominant food of mid sized (12–30 cm long) winter flounder. Quahog siphons made up between 14 and 20% of the total weight of their stomach contents.

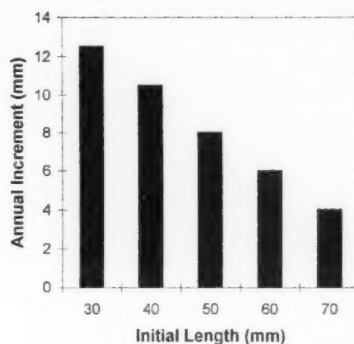


Figure 7.—Growth increment of northern quahogs equal to or greater than a length of 30 mm (From Pratt and Campbell, 1956).

The siphons were typically about 3 mm long and appeared to have been torn rather than severed cleanly. Flounders fed most heavily on quahog siphons in the fall, when other benthic prey might be reduced after a summer of predation by a wide range of fish species and other predators in the bay. A study by Irlandi and Mehlich (1996) suggests this quahog siphon cropping has little effect on quahog shell growth.

Northern quahogs have the capacity to avoid some predation. For example, Carriker (1961) observed the youngest postset quahogs tended to move into shaded microhabitats such as cupped shells and crevices. He also observed higher abundances of the postset quahogs in the microhabitats and suggested they offer shelter from predators. As confirmation of this notion, one of us (MacKenzie) has observed while scuba diving in New Haven Harbor, Conn., that quahogs are more abundant in shelly bottoms than in sandy bottoms. Fishermen in Rhode Island, Connecticut, New York, New Jersey, and North Carolina also find quahogs are abundant in shelly bottoms. In addition, some biologists have reported higher survival of juvenile quahogs in sediments having substantial quantities of gravel (Castagna and Kraeuter, 1977; Kraeuter and Castagna, 1980; Peterson et al., 1995; Summerson et al., 1995) and in eelgrass beds, *Zostera marina* (Peterson et al., 1984).

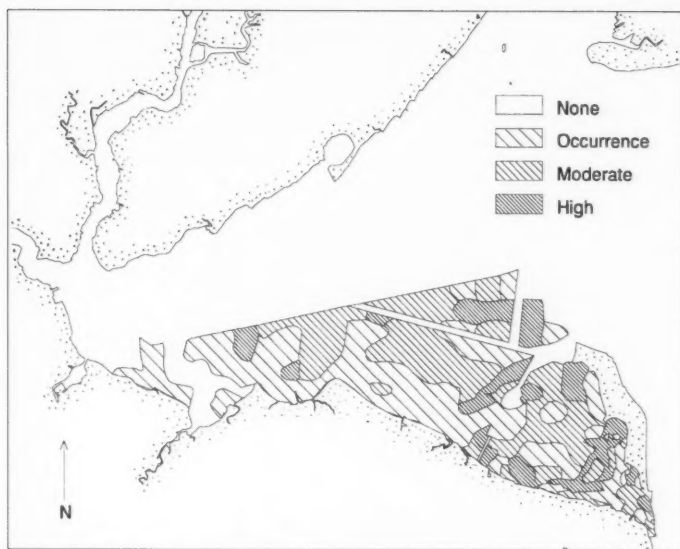


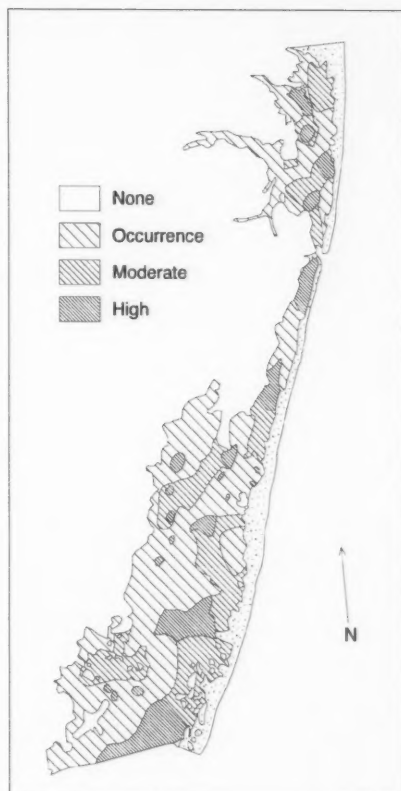
Figure 8.—The distribution of northern quahogs in the New Jersey portion of Raritan Bay, early 1980's (from McCloy, 1984).

Doering (1982) observed starfish can detect quahogs at some distance away in currents flowing toward them, and quahogs can detect the presence of starfish near them. In response, the quahogs decrease their oxygen consumption, pumping rate, and activity. This likely results in decreased attractiveness of the quahogs to starfish. In addition, Doering (1980) observed quahogs burrow more deeply when starfish are present, and as a result are less susceptible as prey. Starfish feed most actively in the spring and fall (MacKenzie, 1970; Doering, 1981).

Roberts et al. (1989) observed quahogs can reduce some predation by herring gulls because they burrow more deeply during low tides and then rise to near the sediment surface when the tides rise again. The stimulus which initiates their up and down movements apparently is the weight of the water over them.

Abundances of larval and juvenile northern quahogs along with many other invertebrate associates are significantly lower in the presence of deposit-feeding eastern mudsnails, *Ilyanassa obsoleta*, than in snail-free areas (Hunt et al., 1987). Deposit-feeding threeline mudsnails, *I. trivittata*, also occur in northern quahog

Figure 9.—The distribution of northern quahogs in the Chincoteague Bay area of Maryland, 1953 (from Wells, 1957).



beds in many areas, and perhaps they may have a similar affect.

#### Diseases

Northern quahogs have not suffered mortalities from the diseases Dermo, *Perkinsus marinus*, and MSX, *Minchinia nelsoni*, that have caused devastation to western Atlantic coast oyster, *Crassostrea virginica*, stocks (Sindermann, 1990; Bower et al., 1994). Ray (1954) and Ray and Chandler (1955) concluded that, in contrast to eastern oysters, quahogs are poor hosts for *P. marinus*, and Andrews (1954) stated while prevalences of *P. marinus* infection in some Chesapeake Bay quahog populations were high, disease severity and mortality in quahogs were extremely low. And in their review of the diseases and parasites of shellfish, Bower et al. (1994) did not list a record of *Minchinia nelsoni* being found in northern quahogs.

In 1998, high mortalities (around 85%) of eastern oysters associated with high *M. nelsoni* and *P. marinus* infections were found in many beds in Connecticut, while no apparent mortalities from the diseases were observed in quahogs in the same beds. In Oyster Bay, N.Y., oysters are similarly killed, but usually the mortalities are lower, but here again northern quahogs are not killed by the two diseases (Relyea<sup>2</sup>).

First noted in the 1960's in New Brunswick, Canada, by Drinnan and Henderson (1963), a disease known as QPX (quahog parasite x), a putative thraustochytrid protozoan (Bower et al., 1994) has been associated with some epizootic mortalities in quahogs. In a broad survey conducted from 1990 to 1998, MacCallum and McGladdery (2000) found it occurs ubiq-

<sup>2</sup>Relyea, D. F. M. Flower and Sons, Bayville, New York. Personal commun., 1999.



uitously in the three marine provinces including the Bay of Fundy. Prevalences in infected quahogs ranged from 1.7 to 42%; however, only 11 of 74 collections (15%) had any QPX.

QPX or QPX-like organisms have been found in quahogs in Massachusetts

(Bower et al., 1994; Smolowitz et al., 1998), New Jersey (Smolowitz et al., 1998), and Virginia (Ragone Calvo et al., 1997, 1998). QPX prevalences in cultured 1–2 year old quahogs from the eastern shore of Virginia ranged from 8–20% in 1996, to 4–48% in 1997,

with associated mortalities estimated at 10–20% (Ragone Calvo et al., 1998).

### Large Bay and Ocean Water Exchange Attributes

In the northeastern United States from Massachusetts through New Jersey, the bays that have a large exchange of their waters with ocean waters now have relatively large stocks of northern quahogs, while those with poor exchanges have small quahog stocks. The areas with large exchanges are Buzzards Bay, Mass.; Greenwich Bay and Point Judith Pond, R.I.; Long Island Sound, Conn.; and Raritan Bay, N.Y. and N.J.. The bays where the exchange is poor are Great South Bay, N.Y., and New Jersey's coastal bays (Barnegat Bay, Little Egg Harbor, and Great Bay). The water in the zones of Great South Bay farthest from the bay inlets exchanges with ocean water only once every several weeks (Nuzzi<sup>3</sup>).

Great South Bay once had large stocks of quahogs. McHugh (1991) reported the opening of an inlet between the Atlantic Ocean and Moriches Bay (which connects with Great South Bay) on Long Island, N.Y., made by a hurricane in 1931, led to a large increase in salinity in Great South Bay. The higher salinity allowed oyster drills to increase in abundance and activity, and they substantially reduced the numbers of remaining oysters (MSX might have also been responsible, Usinger<sup>4</sup>), but dense quahog sets occurred throughout the bay and a substantial quahog fishery developed. Moriches Inlet eventually closed, but a hurricane in 1953 reopened it. By 1957 it began to close again. In 1958 it was widened and deepened by dredging and subsequently protected by a seawall. Jeffrey Kassner<sup>5</sup> believes this 1958 opening may have set the environmental stage for the boom in quahog production in Great South Bay in the 1960's and 1970's.

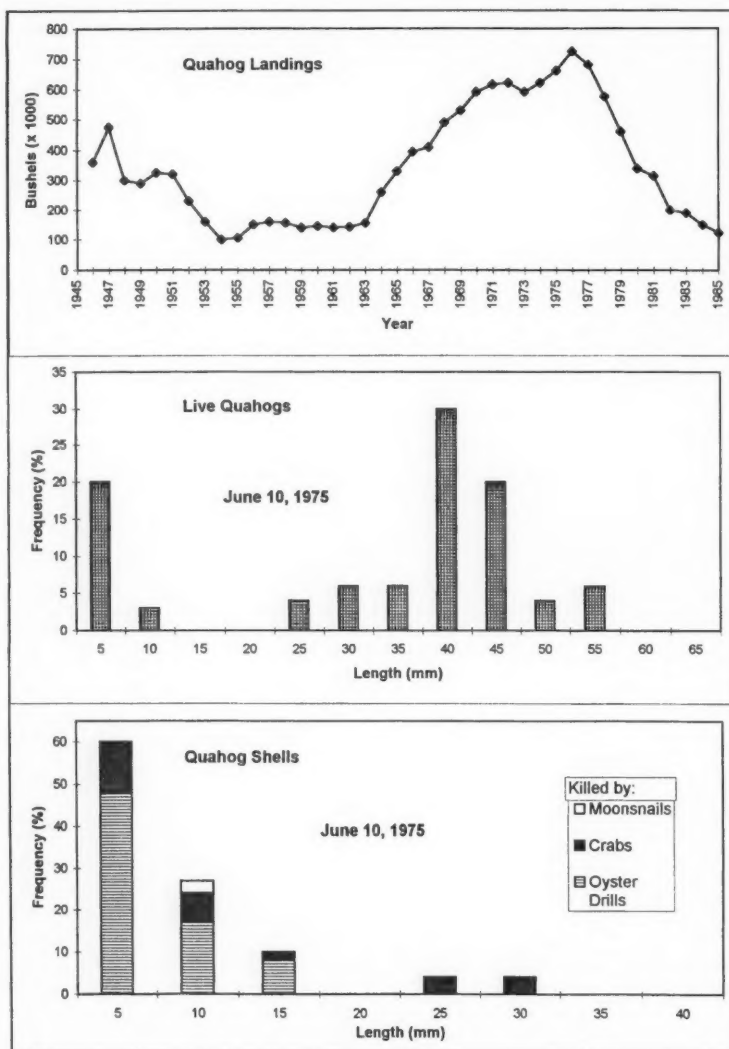


Figure 10.—Data from Great South Bay, N.Y. The upper panel illustrates historical landings in New York (McHugh, 1991). The middle panel shows there were few seed quahogs in the presence of a large number of adult quahogs in 1975 (MacKenzie, 1977). In lower panel, histograms representing the sizes of northern quahogs killed by predators illustrate predation is heaviest on the smallest quahogs (from MacKenzie, 1977).

<sup>3</sup>Nuzzi, R. Department of Health Services, Office of Ecology, Bureau of Marine Resources, Suffolk County, Riverhead, New York. Personal commun., 1999.

<sup>4</sup>Usinger, E. President (retired), Bluepoints Corporation, West Sayville, Long Island, New York. Personal commun., 1999.

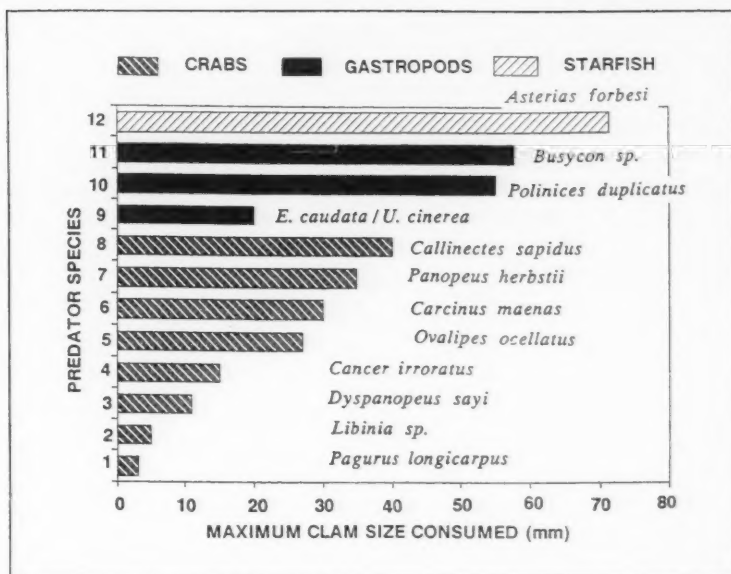
<sup>5</sup>Kassner, J. Town of Brookhaven, Division of Environmental Protection, 3233 Route 112, Medford, New York. Personal commun., 1999.

When environmental conditions for fauna were good in Great South Bay during the 1960's, the invertebrates associated with quahogs were relatively abundant. The invertebrates included dwarf surfclams, *Mulinia lateralis*; Atlantic nutclams, *Nucula proxima*; polychaetes; xanthid mud crabs; and the Atlantic oyster drills, *U. cinerea*, and thick-lip drills, *E. caudata*. Far more dwarf surfclams and Atlantic nutclams were present than quahogs. In 1975, the density of quahogs was about 18/m<sup>2</sup> (MacKenzie, 1977). The two associated clams may have been prey for the predators, buffering the predation on the quahogs.

Moriches Inlet and Fire Island Inlet to its west have remained open, but they partially fill with drifting sand and have to be dredged every few years to maintain them as boat channels. Both have large shoal flats with narrow, shallow channels running through them on their bay sides.

Barnegat Bay, Little Egg Harbor Bay, and Great Bay in New Jersey are lagoons somewhat similar in structure to Great South Bay and Moriches Bay; water depths in all the bays are mostly about 2 meters. Quahogs were relatively abundant in the three New Jersey bays from the 1940's to late 1960's. At the time, water exchange with the ocean was apparently greater. Fishermen relate the rise and fall of the tide in Barnegat Bay then was as much as 45 mm, but substantial shoaling which has since taken place inside the inlets (Fig. 12) has reduced the tidal exchange even further; the rise and fall of the tide now is about 20 mm (Jenks<sup>6</sup>, Lauer<sup>7</sup>). The rise and fall of tide on the ocean beach just beyond the New Jersey bays is about 1.8 meters.

Ingersoll (1877), who surveyed the mollusk fisheries in 1877-78, reported that Barnegat Bay was called "Clam Bay" and yielded 150,000 bushels of quahogs/year. The area now yields barely 1,000 bushels of quahogs/year. Charts from 1878 (Woolman and Rose,



Sources:

*P. longicarpus* (hermit crab)  
*Libinia sp.* (spider crab)  
*D. (Neopanope) sayi* (mud crab)  
*C. irroratus* (rock crab)  
*O. ocellatus* (calico crab)  
*C. maenas* (green crab)  
  
*P. herbstii* (mud crab)  
*C. sapidus* (blue crab)  
*Eupleura caudata* & *Urosalpinx cinerea* (oyster drills)  
*P. duplicatus* (moon snail)  
*Busycon canaliculatus* (whelk)  
*Asterias forbesi*

Gibbons, 1984  
 Gibbons & Blogoslawski, 1989  
 Carriker, 1961; Gibbons, 1984  
 MacKenzie, 1977  
 Gibbons & Blogoslawski, 1989  
 MacPhail et al. 1955 & Taxiarchis, 1955  
 in Gibbons & Blogoslawski, 1989  
 Whetstone & Eversole, 1981  
 Arnold, 1984

MacKenzie, 1977  
 Carriker, 1951; Greene, 1978  
 Carriker, 1951; Greene, 1978  
 Doering, 1981

Figure 11.—The maximum lengths of northern quahogs consumed by 12 common predators in United States Atlantic Coast estuaries (compiled by Bricelj, 1993).

1878) and 1997 (NOAA Nautical chart 12324) show the amount of housing on the shores, the bay itself, the location of Barnegat lighthouse (wide, open arrows on both charts), and widths of the inlets (Fig. 12). Little housing is shown in the 1878 chart, but a considerable amount of housing is suggested by the canalization of the shorelines shown in the 1997 chart (houses crowd the shores of all canals). The buildup of housing took place in the 1960's and 1970's (Collins and Russell, 1988). The width of Barnegat Inlet in 1878 was 4 times its width in 1997. There likely was considerable exchange of bay and ocean waters and little eutrophication of bay waters in the 1870's. This contrasts with limited water exchange

and considerable eutrophication of bay waters in the late 1990's.

Inlets that have been opened by hurricanes seem to have had beneficial effects on quahog populations in North Carolina. Chestnut (1951) stated an increased quahog abundance in northern Core Sound during the mid-1930's appeared to be associated with the opening of Drum Inlet by a 1933 hurricane. Godwin et al. (1971) reported a similar occurrence related to Hurricane Hazel in 1954. Hurricanes do not exert negative effects on quahogs in North Carolina, although the closing of an inlet by a storm has a negative effect. When any North Carolina inlets closed, nearby quahog stocks declined (Taylor, 1995).

<sup>6</sup>Jenks, W. III. Retired shellfisherman, 134 South Beverly Drive, Brick, New Jersey. Personal commun., 1998.

<sup>7</sup>Lauer, R. Quahog dealer, Barnegat, New Jersey. Personal commun., 1999.

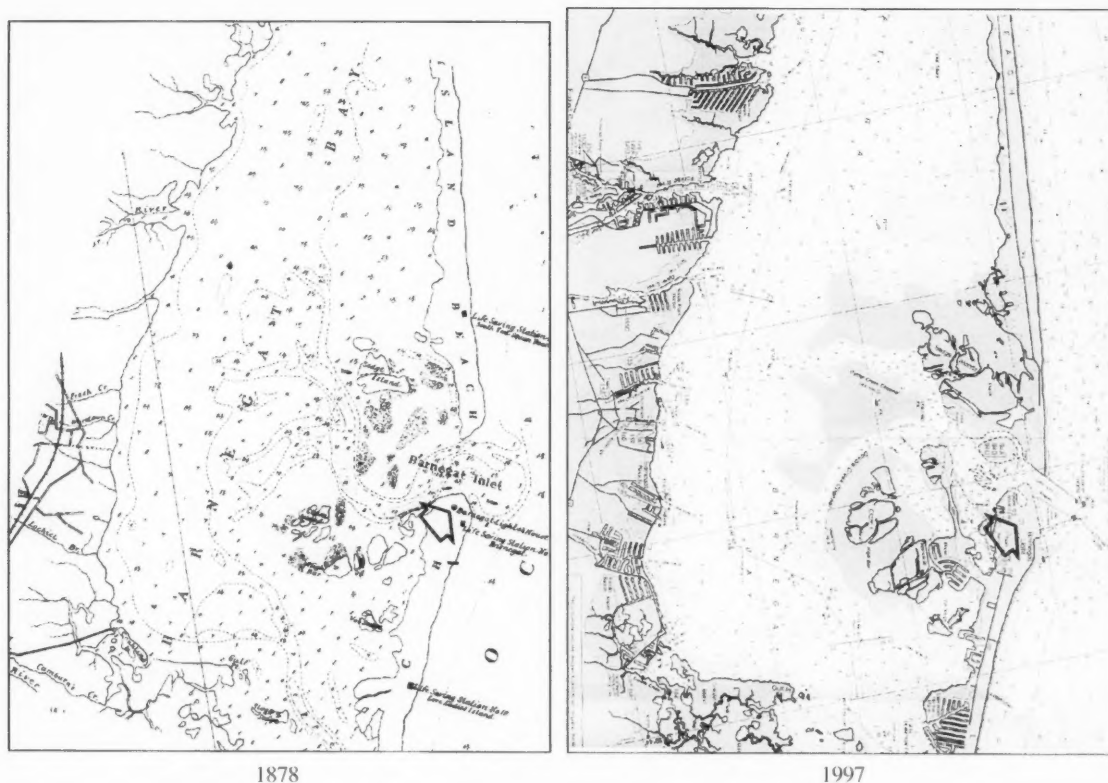


Figure 12.—Two charts of Barnegat Bay, N.J., 1878 (Woolman and Rose, 1878) and 1997 NOAA Nautical Chart 12324. Barnegat inlet was 4 times wider in 1878 than in 1997, and in 1878 little housing was evident on the shores. This contrasts with extensive housing in 1997, as shown, in part, by the canalization of much of the shoreline. Arrow in each points to permanent location of Barnegat Lighthouse.

### Brown Tides

Beginning in about 1985, a pico plankton species, probably *Aureococcus anophagefferens*, has bloomed in Great South Bay, N.Y., and caused "brown tides" of varying intensities throughout the warm months almost every year (Black and Kassner, 1988). Dense blooms of the pico algae force the quahogs to cease feeding and also crowd out the algae that quahogs normally use for food; little usable algae remain. The blooms have been devastating to quahog stocks. One consequence is slow growth of quahogs; it now takes 8–10 yrs for a quahog peliveliger to grow to the minimum legal harvesting size in the bay. During a bloom, which can last for at least a few weeks, the quahogs will

not spawn, but as a bloom declines (in August), the quahogs will spawn and their larvae will develop. The quahogs have become relatively scarce, the fishery has declined sharply, and in most years fishermen observe little seed (Strong<sup>8</sup>).

The invertebrates associated with quahogs have also become scarcer. Few live dwarf surfclams and Atlantic nut clams can be found (only their shells remain) and oyster drills, mud crabs, and polychaetes seem scarcer in the bay.

Another adverse effect of the brown tides is the meats of quahogs become thin and flabby, as though partially starved, and their mantle, gills, and body (except the foot) become dark gray; the fishing

industry refers to the meats as "black" (Fig. 13). At the same time, the meats of quahogs harvested in bays on the north shore of Long Island where brown tides do not occur are plump and have a normal, creamy color. When the brown tides decline, the meats of quahogs in Great South Bay become normal in plumpness and color.

Brown tides are also present in Barnegat Bay, Little Egg Harbor, and Great Bay, N.J. (Mahoney<sup>9</sup>) (Fig. 14). Similarly to Great South Bay, the meats of quahogs become thin and the same tissues become dark gray during dense blooms.

<sup>8</sup>Strong, C. Bluepoints Co., West Sayville, New York. Personal commun., 1999.

<sup>9</sup>Mahoney, J. Microbiologist, James J. Howard Marine Sciences Laboratory, Northeast Fisheries Center, National Marine Fisheries Service, NOAA, Highlands, N.J. Personal commun., 1999.

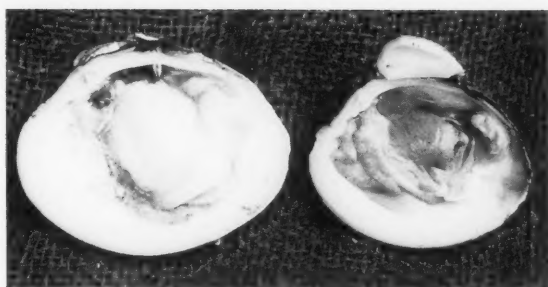


Figure 13.—Quahog meat on left has normal plumpness and pale color, while quahog meat on right is thin and dark gray after being affected by "brown tides."

Figure 14.—The dark shaded area shows the distribution of brown tides in Barnegat Bay, Little Egg Harbor, and Great Bay, N.J., over a 10-year period in the 1980's and 1990's. In that area, chronic blooms (summer long) cause a brownish discoloration; the chlorophyll *a* ranges between 10 and 30 mg/m<sup>3</sup>. In the area along the coast in the Atlantic Ocean, the chlorophyll *a* averages less than 10 mg/m<sup>3</sup>. The numbers show some station locations. (source: State of New Jersey, Division of Watershed Management, Bureau of Freshwater and Biological monitoring, P.O. Box 427, Trenton, N.J. 08625).



The "black" quahogs in both states are more difficult to sell to consumers than the normal quahogs.

The brown tides in bays result from eutrophication of their waters caused by an excess of nutrients they receive. Since the 1960's, a great many homes have been built on the shores of the bays, and much of the nutrients comes from them.

#### Commercial Raking and Quahog Bed Enhancement

Through history, fishermen have observed as they harvested quahogs that seed has continued to set and survive in the beds, and some believed harvesting quahogs with rakes may increase setting densities. In the 1990's, fishermen in Narragansett and Raritan Bays related similar observations, saying, "We keep taking quahogs from these beds and they keep coming."<sup>10</sup> The observations were confirmed by studies in Narragansett Bay

by Rice et al. (1989), who showed active fishing, which removed adult quahogs from beds, might have led to an increase in the abundance of juveniles.

#### Historical Overview

##### Native Americans and Quahogs

Ingersoll (1887:598) reported that quahogs were a valuable food for some east coast Native Americans: "The Indians, who had no machinery for aiding them, caught them by wading in and feeling for them with their toes, something the early colonists quickly learned to do. Another way was by diving; this was the work of the [women] and the older children, and was, of course, exceedingly laborious. The chief use of clams in the early days was in summer and fall. Then the Indians came to the sea-shore for their greatest festival, that of green corn. On such occasions a great assembling of sages and warriors with their families was held at the beach. Clams, succulent

ears of corn, and seaweed were roasted together in astonishing quantity. So good a custom merited perpetuation, and has, indeed, survived to the present day in the 'clam-bake.'" Ingersoll (1887) further reported that the Indians preserved quahogs and oysters for winter use by drying their meats in the sun on pieces of bark and that the Indians left middens of shells (quahogs, oysters, mussels, and others) (Plate 1, left) on estuarine and bay shores along the entire east coast of Canada and the United States.

In his book "Travels" in 1748, Peter Kalm (1937 edition) describing the use of quahogs in New York wrote that, "A considerable commerce is carried on in this article, with such Indians as live farther up the country. When these people inhabited the coast they were able to catch their clams, which at that time made a great part their food; but at present this is the business of the Dutch and English, who live in Long Island and other maritime provinces. As soon as the

<sup>10</sup>Personal commun.



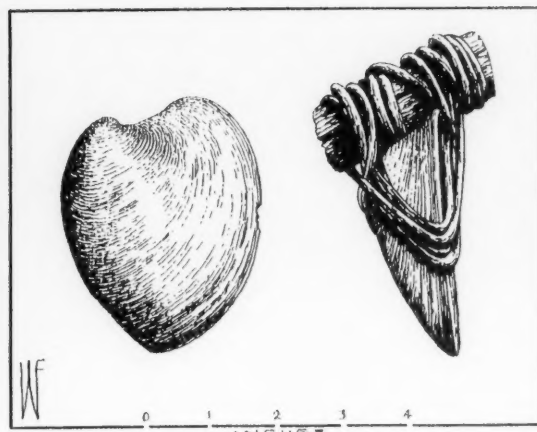


Plate 1.—Native Americans and quahogs. Left, quahog shell midden near Buzzards Bay in Marion, MA; Right, quahog shell hoe.

shells are caught, the fish is taken out of them, drawn upon a wire, and hung up in the open air, in order to dry by the heat of the sun. When this is done, the flesh is put into the proper boats, and carried to Albany upon the river Hudson; there the Indians buy them, and reckon them one of their best dishes. Besides the Europeans, many of the native Indians come annually down to the sea-shore, in order to catch clams, proceeding with them in the manner I have just described."

The Indians used quahog shells as scrapers for hollowing out and shaping the bows of their canoes and in shaping the insides of bowls, and as knives, spoons, and hoes (Plate 1, right), and crushed shell was a common tempering material for their pottery. Using two bivalve shells, the Indians in Virginia grated off the hair from one side of their head (Swanton, 1946; Russell, 1969–1970; Axtell, 1981; Stanzeski, 1981; Rountree, 1989), while some groups of Indians plucked all the hair off their bodies using two quahog shells as tweezers (Adair, 1775).

### History of Wampum Making and Usage

This section on the historical use of the shells of northern quahogs and whelks as the raw material to make wampum beads and their usage in the 1600's, 1700's, and 1800's is largely extracted from an article entitled, "The Manufacture

and Use of Wampum in the Northeast," by U. V. Wilcox (1976), and a book entitled, "Trade Wampum, New Jersey to the Plains," by L. E. Williams and K. A. Flinn, and published by The New Jersey State Museum in 1990. The book describes the manufacture of wampum in southern New England, New York, and New Jersey and its distribution and usage. Nearly 45 additional references and several personal communications are also cited. Shell beads from other mollusks were made by the Indians in Maryland, Virginia, and the Carolinas (Swanton, 1946; Massey, 1976; Rountree, 1989). Over time, wampum was used by the Indians as a "primitive valuable," and by the Dutch as cash and finally as a commodity to be sold in exchange for cash (Philhower, 1928; Peña, 1990). The Indians did not use wampum beads as money as is commonly believed. The various uses of wampum by the Indians, Dutch, and English are presented in Table 4.

### Purple and White Wampum

The word wampum is a shortened form of wampumpeag or wampumpeake, an Algonquian word of southern New England meaning a string of shell beads. Wampum beads were either purple or white. The purple beads ranged from deep purple to lavender; they were made from the purple area roughly 15 mm wide

Table 4.—Uses of wampum by the Indians, the Dutch, and the English (from Peña, 1990).

|                        | Indians | Dutch | English |
|------------------------|---------|-------|---------|
| Prestation             | X       |       |         |
| Ransom                 | X       |       |         |
| Bridewealth            | X       |       |         |
| Compensation for death | X       |       |         |
| Treaties               | X       | X     | X       |
| Trade                  | X       | X     | X       |
| Cash money             |         | X     | X*      |
| Commodity              |         | X     |         |

\*Infrequent

located around the anterior edge on the interior of large northern quahog shells. Most white beads were made from the central columns of the knobbed whelk, *Busycon carica*; smooth whelk<sup>11</sup>; and, according to published reports, the waved whelk, *Buccinum undatum*<sup>12</sup>; the remaining white beads were made from the white portions of quahog shells. One or two purple beads could be made from a quahog shell, while several white beads could be made from a whelk or quahog shell. In the Indian culture, purple wampum symbolized important affairs of

<sup>11</sup>Probably unwittingly, the Indians in gathering whelks were practicing control of quahog predators. They also gathered horseshoe crabs, which prey on softshell clams and other bivalves. They removed the tails from horseshoe crabs and used them as spear points (Swanton, 1946).

<sup>12</sup>Perhaps the waved whelk was misidentified and the actual species were the northern moon-snail, *Euspira heros*, and shark eye, *Neverita duplicata*, both of which are common in intertidal areas south of Cape Cod, whereas the waved whelk is common north of Cape Cod.



a civic nature, whereas white wampum represented purity, faith, well-being, and peace (Wallace, 1993; Tehanetorens, 1993).

Indian artisans first ground the shell piece into a round, smooth bead using a gritty stone, and originally may have used fine bone needles and flint-tipped tools along with sand to make holes in the beads which were drilled from both ends. Peña (1990) said the whorls of whelks were first hammered away to reveal the columella. This column was then ground smooth, sliced, shaped, and then drilled. She said the archaeological evidence for seasonality in wampum making is unclear, and she suggests men made the beads, while women strung them. In the early 1600's, wampum beads were about 6 mm in length and 3 mm in diameter.

#### Prehistory

Historians know the prehistoric Indians made beads from the shells of some mollusks, but they are divided over whether they made purple wampum from quahog shells. Wilcox (1976) said knowledge of purple wampum making in precontact times is obscure, and the occurrence of wampum beads at Indian sites in the northeast is rare or nonexistent. He believed the Indians had the technology to make purple wampum; it would have involved the use of a rod and an abrasive, but it would have required considerable patience and effort.

But some authors, after examining purple wampum beads in museums, concluded the Indians could not have made the beads without the use of fine metal drills probably first supplied by the Dutch (Beauchamp, 1901; Slotkin and Schmitt, 1949; Winters, 1968; Orchard, 1975; Ceci, 1977, 1980; Salwen, 1978; Becker, 1980). Hamell (1996) said, "white marine shell beads conforming in size and shape to wampum beads have been found at archaeological sites of northeastern woodland Indians spanning the past 4,000 years. Dark purple beads, on the other hand, have not been found at prehistoric sites; rather, they make their appearance in the archaeological and documentary record around 1600. It is very probable these purple beads were initially manufactured by coastal Indian

communities to imitate the dark blue glass beads of similar size and shape then traded along the coast by Europeans." Tubular shell beads were made before European contact, but stone tools meant they were thick and had large bore holes (Fenton, 1971, quoted by Peña, 1990).

Historians also doubt whether the Indians who inhabited coastal areas south of Long Island ever made purple wampum. Kraft (1986) said the Lenape (Delaware) Indians who inhabited the shores of Staten Island, N.Y.; New Jersey; and northern Delaware made practically no purple wampum. Bays on the east coast of the Delmarva Peninsula have had large quantities of quahogs, but purple wampum was not found in any prehistoric Indian sites. Nevertheless, large numbers of shell beads, as old as 1,500 yr or more, made from snails, *Marginella* spp., and whelks, were present in the sites, and quahog shells representing food remains were common. Perhaps the quahog shell was too hard to work easily with available pre-metal technologies.<sup>13,14</sup> In addition, purple wampum has not been found at prehistoric Indian archaeological sites bordering Chesapeake Bay in Maryland and Virginia, but the sites contain thousands of beads made from the shells of *Marginella* spp., mussels, and the central columns of whelks. Various shapes of round, barrel, and pipe beads were made from the columns of whelk shells, and small to large circular pendants, made from the outer whorl of the whelk, are also common in those prehistoric sites.<sup>13</sup>

#### Some 1600's Shell Heaps

The Indians who made wampum in the 1600's were the Mohegans, Narragansetts, Niantics, and Pequots, tribes of southern New England, and Corchaugs, Montauks, and Shinnecocks, tribes of Long Island. They used European-made metal drills. The introduction of the drills allowed a huge enlargement of the Indian bead manufacture industry (Wilcox, 1976).

Burggraf (1938), who excavated and examined shell heaps on the coast of Long Island, wrote, "The manufacture of wampum may have been an important Long Island aboriginal industry but it is doubtful it was an industry of any great antiquity. Of a dozen or more heaps examined or excavated by myself or friends from 1932 to the end of 1935 at Bayside, Glen Cove, Center Port, Northport and Stony Brook, only one contained definitely cut and ground whorls of whelks showing a well-advanced understandings of the methods best suited to the manufacture of small white wampum. This solitary midden at Northport contained some fifty carefully ground distal ends of the central stock, or columella, of a large univalve which, from its size and from the abundance of other parts of the shells nearby, were obtained from the "knobbed whelk" (*Fulgar* [= *Busycon*] *carica*). Though this heap was large, there were but half a hundred specimens of wampum "blanks" in the portion excavated by myself which embraced an area of some 40 by 35 feet (12 by 10.7 m). I am of the opinion that the greater part of the refuse was deposited not over 350 years ago.

"Another shellheap was found south of the town of Massapequa and less than one-half mile from the waters of Great South Bay. Its most interesting feature was the profusion of not only the cut columellae of whelks, but the hundreds of small bits broken out of the anterior end of gigantic hard clams. Though all were decomposed to a pale lavender shade, the centers, after being broken open, proved to be a deep purple. Here without a doubt was the site from which much of the early Dutch trade wampum was obtained."

"Without European tools, any form of wampum making was a slow and difficult labor, and even after their introduction the task was one that required a high degree of skill and no little patience. Articles recovered from this site that were quite probably implements of the shell workers' trade, and several that are problematical, were as follows:

"Quartz or quartzite pebbles showing no battering beyond the removal of a few chips from one end. These may have

<sup>13</sup>Letter dated September 22, 1999 from K. Egluff, Assistant Curator, State of Virginia, Department of Historic Resources, Richmond.

<sup>14</sup>Letter from E. Chaney, Maryland Archaeological Conservation Laboratory, St. Leonard.

been either hammerstones, smoothers, or perhaps only the source of the occasional quartz or quartzite flakes scattered through the heap.

"Quartz chips, with the addition of one fragment of a chipped chert blade, represent the only chipped-stone relics. They would have served well in sawing through the flinty shell, their greater hardness rendering them even more efficient than a steel or iron knife.

"Several sandstone abraders, pieces of a very abrasive red sandstone, that were ground square on one edge. As this stone does not occur naturally on Long Island, it must have been brought in from elsewhere. Grinding with this material was the most efficient method of shaping the hard columns of the 'winkles' or 'conches.'

"Iron nails and spikes were of common occurrence and might have served as either hammers, pressure flakers, or awls depending on the size."

Lawson (1860), referring to Virginia and North Carolina Indians during the colonial period, reported they drilled holes in shell beads using a nail stuck in a cane or reed. Holes in *Marginella* shells were made by grinding down the shell opposite the aperture.

#### *Wampum as Currency*

Wampum is commonly believed to have been used as currency by Indians before the Europeans came to North America in the early 1600's, but this has been impossible to prove (Holmes, 1881; Wilcox, 1976; and other authors). If any wampum were present during prehistoric times, it probably was used as barter if exchanged. Wampum was termed "Indian money" later when the European colonists used it in trade with the Indians. The scientific name *Mercuraria*, given by Linnaeus when he learned of its use to make money, acknowledges the quahog's role as money.

The wampum industry was carried on primarily during the colonial period, when wampum was used to an extent as currency because European coins were often in short supply; European nations did not want to let their currency out of their countries (Wilcox, 1976). The Dutch had come to North America as

urban merchants and traders (Peña, 1990), and in the small Dutch colony of New Netherlands, wampum was used as its currency for everyday transactions of all kinds throughout its existence in the 1600's, the main period being between about 1637 and 1667 (Wilcox, 1976). As a tribute to the importance of wampum, they used a string of wampum encircling a beaver in their design of the official seal of New Netherlands (Francis, 1986). The Dutch settlers referred to wampum as "seawan," "seawant," or "zeewand" (Stearns, 1887), because this is what they believed the Indians were calling it. The Indians actually were referring to their name for Long Island, i.e. Sewounhocky, or land of the shells (Irvin, 1987), and the Dutch shortened it (Molloy, 1977). Wampum remained legal tender among the Dutch in New York some 40 years longer than in New England, to as late as 1701 (Kammen, 1975 quoted by Peña, 1990; Francis, 1986). The colonists also practiced commerce by bartering rather than using wampum or coins at least as late as 1800 (Furnas, 1969).

In New England, the English colonists, who came to North America as Pilgrims and farmers, used wampum far less than did the Dutch. The English used it almost entirely within the sphere of Indian relations, and from 1634 to 1664, at least 17,000 fathoms of wampum (over 9 million beads) entered the English colonial economy from Indian sources (Ceci, 1980), but they used coin whenever possible amongst themselves (Peña, 1990). The English acquired wampum from Algonquians, who manufactured the beads in specialized manufacturing centers or "mints," located in coastal areas. But in New England, wampum was little more than a temporary convenience, soon left behind for coinage and paper currency (Kammen, 1975, quoted by Peña, 1990).

One reason the colonists used wampum was that it was durable, easily divided, not bulky, and difficult to manufacture; an estimate of production is 36–48 beads/person/day (Ceci, 1980). Because the purple beads were more difficult to make, they were worth about twice as much as the white beads; both had their equivalents in Dutch guilders, English

shillings, and Swedish Riksdalers (Kraft, 1986). The ratio of value between European-made coins and wampum fluctuated many times during its use as currency. In 1634, 4 wampum beads were worth 1 stiver (20 stivers made a guilder) in New Netherlands, but their value kept falling. By 1648, 6 wampum beads were worth 1 stiver, and, by 1661, 8 wampum beads were worth 1 stiver (Hagerty, 1985). In 1643, Massachusetts made wampum legal tender for any sum not exceeding 40 shillings; fixing the value of purple beads at four to a penny and white beads at eight to a penny. In 1649, Rhode Island set the value of purple beads at four to a penny (Hepburn, 1915).

The colonists in the northeast obtained wampum from the coastal Indians of southern New England and Long Island by exchanging it at low rates for European-made goods, which included guns and powder, blankets, fabrics for clothing, metal tools, fancy ribbons, and trinkets. The Indians became increasingly dependent on such goods for survival. The items had been purchased cheaply in Europe while furs, which the colonists obtained from other Indians and then sold to dealers in Europe, brought high prices. In dealing with Indians, the colonists measured wampum, usually strung on hemp string, in fathoms. With about 15 beads to the inch, a fathom had about 1,080 beads (Peña, 1990). Colonists determined the lengths of the strings by measuring the distance from their elbow to the end of their little finger (18 in).

A few references list the relative value of wampum to game animals, fish, and purchased metal items. A beaver skin was worth 252 white wampum beads in 1628, but by 1632–36 its value soared to 1,080–1,440 beads (Ceci, 1980). In 1631, 160 wampum beads purchased a beaver skin, and, in 1643, Indians traded a turkey or a salmon for 80 wampum beads (Hagerty, 1985). Schoolcraft (1852), referring to the Sioux Indians who inhabited Minnesota and South Dakota, wrote, "Traders formerly sold from 2–5 strings (of wampum; probably about 50 beads/string) for an otter (skin). At the present time, 10–20 strings (of wampum) are given for an otter's skin." Among North Carolina Indians, 360 wampum beads

purchased a dressed doe deer skin and 500–575 wampum beads purchased a dressed buck deer skin (Swanton, 1946). A knife or 100 nails sold for 32 wampum beads, a hatchet for 120–160 beads, and, depending on its size, a brass kettle for between 80 and 480 beads (Hagerty, 1985).

One reference refers to wampum's value in payment for a transportation service. In the early Dutch days, a primitive ferry conveyed travelers between Long Island and New Amsterdam (later known as Manhattan). A whelk shell horn was hung on a tree by the water. The traveler alerted the ferryman by blowing through the shell to make a loud sound. The ferryman dragged his scow from the bushes and rowed or sailed him across for a fare of 3 stivers, which was paid in wampum (Irvin, 1987).

Personal relations between the Indians and the European colonists were not always peaceful. Because some Indians were hostile to the colonial activities, some colonists offered bounties on them, and in 1641, the Dutch paid 10 fathoms of wampum for each hostile Raritan Indian killed (Axtell, 1981).

#### *Wampum as Ornamentation*

The Indian tribes of southern New England and Long Island and the Iroquois, who obtained wampum in trade with them and who were distributed over a large area of northeastern North America, strung the wampum beads on vegetal matter such as the inner bark of softwood trees including the elm. They used them as personal ornaments, such as headbands, neckbands, necklaces, and armlets, to braid hair, and they also sewed them onto articles of clothing along with fruit pits, bones, and soft stone (Ingersoll, 1883; Swanton, 1946; Speck, 1974; Anonymous, 1981; Kraft, 1986).

In using wampum as earrings and necklaces, the Indians usually alternated purple and white beads. The Indians' use of beads as ornaments furnished visible witness as to the social standing of the wearer. Since wampum manufacture required a large amount of work, the amount of wampum one wore was associated with one's social status (Wilcox, 1976). Westervelt (1924), who compiled

some early information about wampum, wrote: "The Indians were fond of display, and the greater their wealth the more they wore decorations. The chief's motive in adornment was to mark individual, tribal, or ceremonial distinctions. The moons (round shells 7–15 mm in diameter cut from the lips of whelk shells) were very popular and were worn mostly as we wear breastpins; the wealthy chief had a full set, while the poor brave had only two or three of the smaller size, while even single ones were worn."

#### *Wampum Strings and Belts*

The Indians also strung wampum beads on strings to be used for symbols or agreements of various significance (Fig. 15A). Purple and white beads were strung in different order or color combinations to convey or record an idea or thought that could be interpreted without confusion (Clarke, 1931). The beads could also be strung in one color, white or black (purple). A string of white beads signified peaceful relations, whereas a string of black beads signified war (Schaaf, 1990). Among the New York Indians, strings of wampum beads were used in condolence councils (Beauchamp, 1981 [1907 reprint]), while Maine's Penobscott Indians used them as an instrument in the proposal of marriage (Speck, 1974).

As wampum became more plentiful in the 1600's and 1700's, the Indians often wove the beads into belts, which varied in length, width, and style of beads (Fig. 15B). Morgan (1852) wrote: "In belt-making 8 strands or cords of bark thread are first twisted from filaments of slippery elm, of the requisite length and size; after which they are passed through a strip of deerskin to separate them at equal distances from each other in parallel lines. Next, the beads are strung on them. In ancient times, the threads were of sinew."

The belts varied from 5 or 6 beads wide to as many as 50 beads wide, but most were 10–15 cm wide and 30–180 cm long. Old belts surviving today contain an average of 1,980 beads (Opitz, 1995). The purple and white colors enabled the Indians to make geometric designs or shapes of human figures in the belts, which often became mnemonic devices,

recording a particular event or treaty. It was traditional to exchange wampum belts when agreements were made, to make them binding upon all parties. Wampum belts eventually became authority symbols (Clarke, 1929).

Westervelt (1924) noted that, "In all affairs of state the chief and sachems wore wampum belts around their waists or over their shoulders. In negotiations with other tribes, every important statement was corroborated by laying down one or more strings of wampum or belts. Friendships were cemented by them, alliances confirmed, treaties negotiated and marriages solemnized. In all these the giving of wampum added dignity and authority to the transaction. 'This belt preserves my words,' was the common phrase among the Iroquois when promises were made." The belts comprised the only non-oral history a tribe possessed of its treaties, councils, and other major events.

The colonists had become aware of the ceremonial importance of wampum in treaty ratification and were careful to include wampum exchange in their proceedings to prevent the Indians from claiming treaties were invalid by their tradition (Peña, 1990). The formal exchanging of strings and belts among the Powhatan Indians in Virginia was a later development that spread from New England (Rountree, 1989).

In 1976, Schaaf (1990) found documents written in the 1770's by George Morgan, a frontier explorer, trader, and the agent of the colonies' Indian affairs during the Revolutionary War. Morgan was familiar with various Indian cultures from the Great Lakes to the Ohio River and from the Appalachian Mountains to the Mississippi River, and he attended many Indian meetings and documented what he saw and heard. During this period, the Indians were striving to preserve their independence and culture and to protect their hunting preserves, all threatened by Americans encroaching upon their lands. Morgan's documents confirm that wampum belts were an Indian version of legal covenants equal in importance to a Declaration of Independence or a Constitution. A string or a belt of wampum symbolized a policy to the Indians. Morgan referred

to it as "wampum policy." When a visiting Indian was delivering a message to another Indian tribe or village, he held up the string or belt of wampum he was carrying and then spoke. A string of white beads meant he was going to speak of peace between the Indians and Americans, whereas a string of black beads

were followed by words urging they band together in war against the Americans. If a tribe accepted the belt, it agreed with the message; whereas if the tribe cut up the belt, that symbolized total rejection of the accompanying message.

The Onondaga Nation in central New York State is the wampum keeper of

the Haudenosaunee. It now has 12 rare wampum belts in its possession. Four important ones are known as the Hiawatha (Plate 2, top), the Washington Covenant (Plate 2, bottom), the Tatataho, and the Everlasting Tree belts. The Hiawatha Belt (5,682 black beads and 892 white beads; Tehantorens, 1993) is the original record of the formation of the Haudenosaunee, which was the Union of the Five Nations (Mohawk, Oneida, Onondaga, Cayuga, and Seneca); it has a background made of purple beads and diagrams made of white beads that form four squares and a tree (the five diagrams symbolized the Five Nations and the tree symbolized the Haudenosaunee nation).

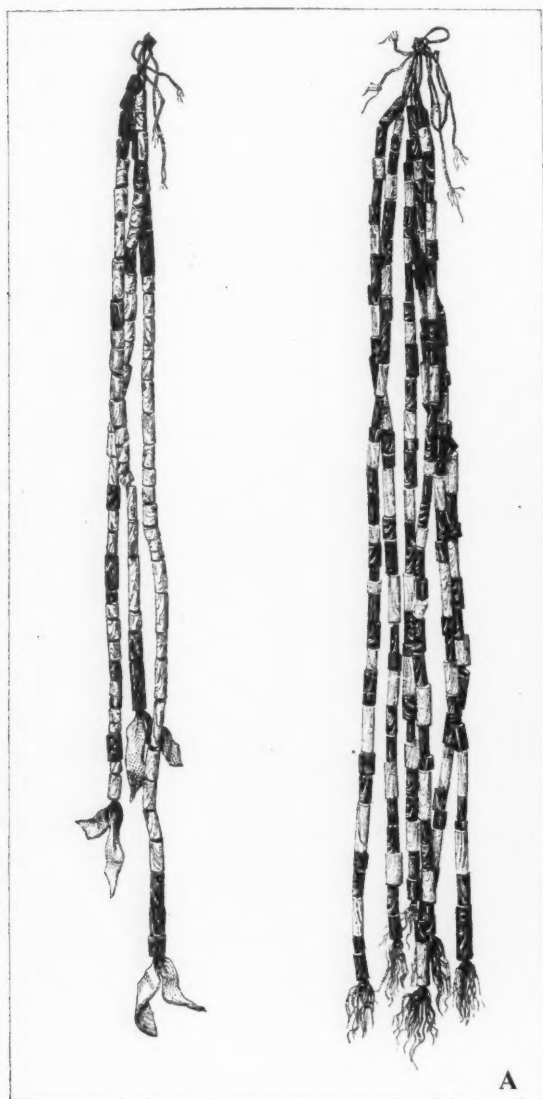


Figure 15A.—Strings of wampum. Left: Name of new Chief. Right: "Mohawk."



Figure 15B.—Wampum belts (Neg. 17292, Photograph by J. Kirschner), courtesy Dep. of Library Sciences, American Museum of Natural History, New York, N.Y.)



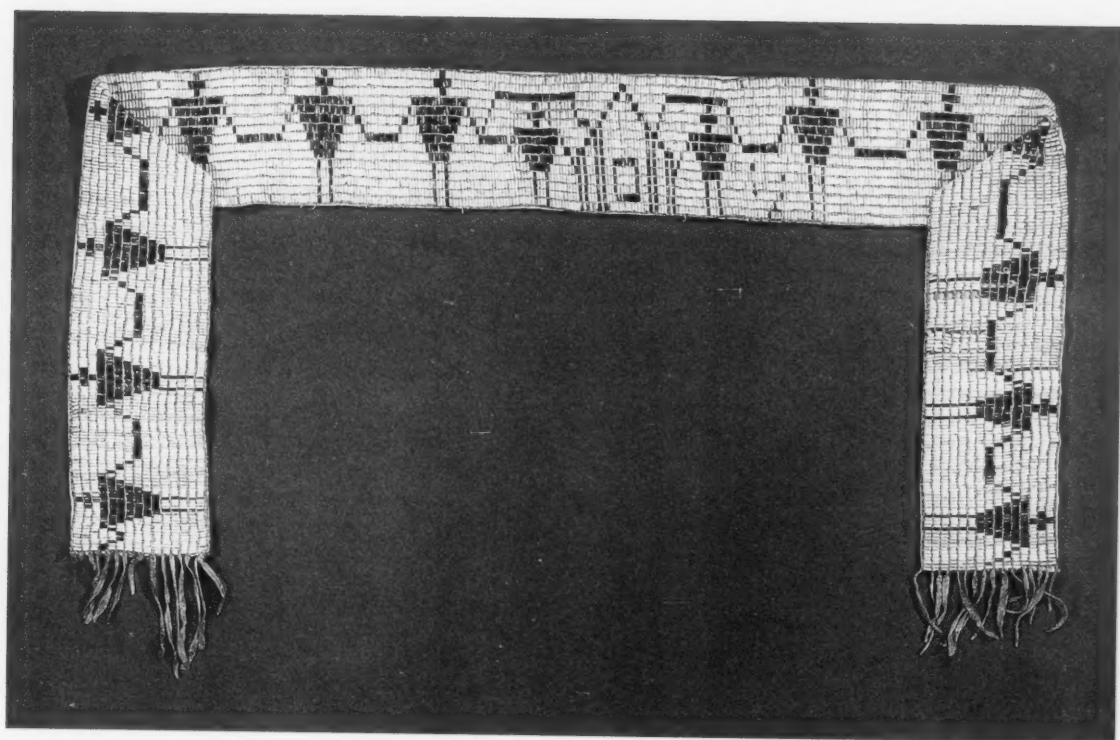
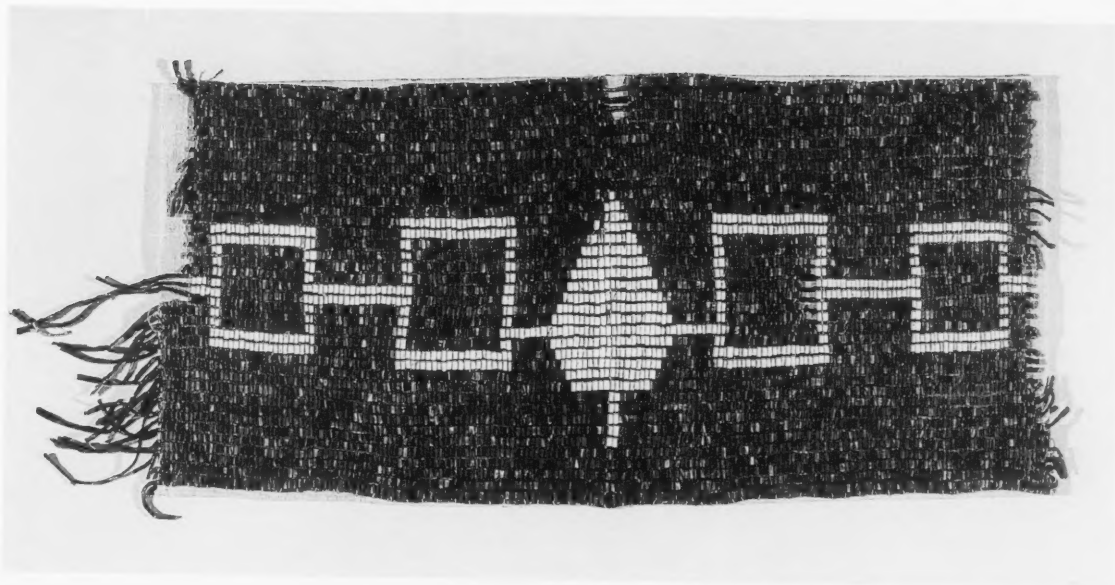


Plate 2.—Wampum belts. Top, Hiawatha; Bottom, Washington Covenant.



The Washington Covenant Belt, 1.9 m long and 13 cm wide, has 8,355 beads. Symbolic figures of 15 men with outstretched arms and clasped hands are woven in purple beads across its field of white beads. In the belt's center is a figure of a house that represents the Longhouse (Capital Building) of the Haudenosaunee and the two end figures are thought to be the keepers of the eastern door (the Mohawks) and the western door (the Senecas). Its remaining figures signify the 13 fires of the original 13 states and its white field denotes peace and friendship.

This belt represents a record of a U.S. Government treaty with the Haudenosaunee at Canandaigua, N.Y., on November 11, 1794. George Washington signed this treaty, and the U.S. Department of Interior still sends the annuities (\$4,500 worth of muslin cloth which the Indians use to make curtains, dresses, and other items) to the Haudenosaunees every year as stipulated in the treaty, to show the treaty remains in effect. The Tatataho belt (7,740 beads; Tehanetorens, 1993) and the Everlasting Tree belt commemorate the formation of the Haudenosaunee, who are known today as the Six Nation Confederacy or the Iroquois (Powless<sup>15</sup>).

Another famous historical wampum belt is the William Penn (449 black beads and 2,394 white beads; Tehanetorens, 1993), which the Lenape Indians delivered to William Penn at the great treaty made under an elm tree at Shackamaxon (a part of Philadelphia called Kensington) on the shore of the Delaware River in 1682. This action symbolized a pledge of friendship (Anonymous, 1944). The Museum of the American Indian, Heye Foundation, issued an over-sized leaflet that describes two wampum belts given to Penn by the Indians (Anonymous, 1925); and a historical novel entitled, *The Wampum Belt a Tale of William Penn's Treaty with the Indians*, was written by Butterworth (1924).

#### Wampum and Fur Trading

From the mid-1600's onward, the English, Dutch, French, and Swedish colonists in northeastern North America were



Figure 16.—Trading wampum for furs, 1770's.

engaged in fur trading, the furs mainly from beaver, but also otter, marten, and mink (Fig. 16). Many Indians caught the animals and sold their skins to the colonists in exchange for wampum beads and other items. The wampum beads had to be of good quality, i.e. regular in size, smooth, and bored completely through, or the Indians rejected them. In selling fur, the Indians were left short of their usual clothing and so European fabrics, second to wampum, were the most important items they exchanged for fur (Cronon, 1983).

A vast network of trade and flow of commodities became established between tribes which heretofore had little intercourse with one another, except on a hostile basis. In this trade in which the colonists wanted furs, Indian wampum was the primary unit of exchange (Wilcox, 1976). Ceci (1980) suggests the following exchange sequence, or trade triangle,

took place: "Inexpensive trade goods such as duffles (heavy blankets) were brought to the Algonquian Indians in the coastal New York area and exchanged for the locally produced wampum; the wampum was next transported inland where it was exchanged at higher rates for the furs of the inland natives; these furs were then shipped to Europe to be sold at great profit to the original investors and suppliers of the trade goods. That this scheme was indeed quite profitable can be seen in the list of annual fur shipments sent from New Netherlands to Holland from 1624 to 1632. The count of beaver skins alone rose from 1,500 to 15,000, and the total value of all furs each year rose from 28,100 to 143,125 guilders. But the spiraling profits were apparently affected by inflation. This inflation can, in part, be explained by the growing demand for both wampum and furs by many competitors. They included not only Dutch West India Company em-

<sup>15</sup>Correspondence with Irving Powless, Chief, Onondaga Nation, New York State.



Figure 17.—Left: Plains Indian wearing beads (From Library of Congress, Washington, D.C.). Above: Plains Indian in dress regalia including a large vest of hair pipes, 1800's. Illustration on display at Pascack Historical Society, Park Ridge, N.J.

ployees, Dutch colonists, and a variety of individual traders (including Indians) but also English colonists of New England. The English were increasingly successful in their search for wampum supplies, for by 1634 their Maine fur trade was dependent upon this commodity." According to Francis (1986), fur pelts received from the Indians yielded a 900% profit in Europe.

The fur-bearing mammals gradually became scarcer as a consequence of extensive hunting, and so traders sought furs from Indians farther to the west and north. The trading extended to the Great Lakes and north into what is now Canada (Peña, 1990). Those Indians also highly valued wampum and European goods;

the demand for wampum on the part of the Indians being continuous (Hagerty, 1985).

The mid-western Indians also liked wampum. In 1785, the U.S. government began to establish trading posts for the Indians as far west as the Mississippi River. European-made goods, such as cloth, blankets, knives, and glass beads, were a staple of the trade, but records of the posts also show a strong demand for wampum beads for use as ornaments from Chicago to Louisiana. The orders ranged from 10,000 to 200,000 beads. In the early 1800's, as fur traders, especially employees of the American Fur Company, went further west, they needed wampum for trading with the

Plains Indians. Besides wampum beads, the Indians also wanted hair pipes (tubular white beads averaging about 7–8 cm long and made from the columns of whelk shells) and moons. The pipes and moons frequently were made from queen conch, *Strombus gigas*, shells which originated in the West Indies. Various paintings and photographs of Plains Indians in the 1800's show their extensive use of wampum and other ornaments (Fig. 17). Available records show wampum was included among presents and traded goods given to Indians near the Rocky Mountains just after 1800 (Larocque, 1981) and near the Missouri River in the mid-1800's (James, 1984; Kelley, 1990).

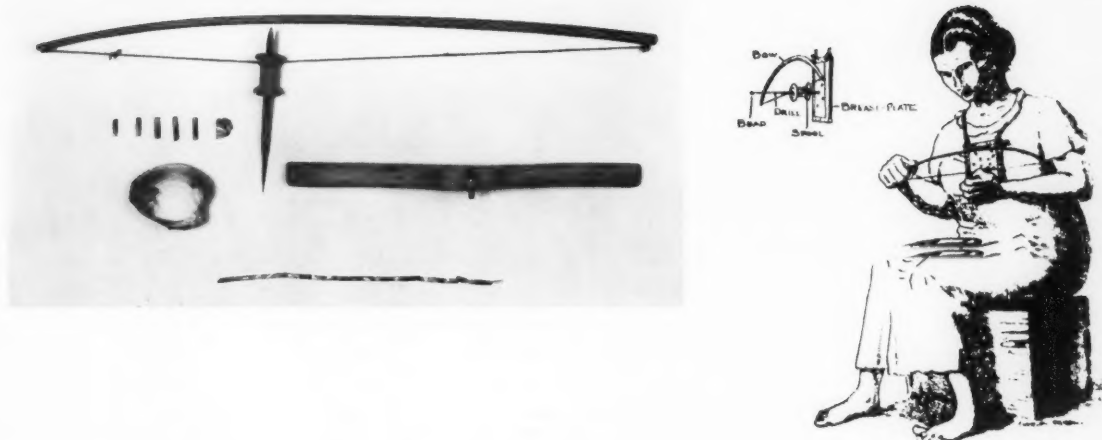


Figure 18.—Wampum making. Left: Wooden bow 60 cm long was used to spin the drill to make holes in quahog shells. Photograph courtesy of National Museum of the American Indian, Smithsonian Institution. Right: Farm woman of Bergen County, N.J., drilling a hole in a wampum bead, 1800's. Illustration on display in Pascack Historical Society, Park Ridge, N.J.

Northern fur traders took less wampum to Indians in Virginia and the Carolinas than to those in the northeast and the Plains (Swanton, 1946). In discussing Virginia, Beverley (1705) reported the English who traded with Indians valued the purple wampum at 18 pence/yard and the white wampum at 9 pence/yard. Wampum beads dating from 1700 have been found at an Indian site, called Occaneechi Town, located 16 km north of Chapel Hill, in North Carolina. The beads had been manufactured in the northeast and came to the area in trade (Hammett, 1998).

By around 1700, the Indian-made supply of wampum had become much smaller as a result of dwindling Indian numbers and because the Indians buried it in the graves of their dead. However, the demand for wampum remained strong in the fur trade and in other dealings with the Indians such as political negotiations. Colonial envoys dealing with the Indians sent wampum strings or belts as credentials showing their right to conduct negotiations and to validate statements in a treaty. The belts were meant to be kept intact to continue the agreements they had served to seal. The quantity of wampum used in these activities kept

increasing through the 1700's, in part because the numbers of wampum beads used in the belts kept increasing in treaty meetings from the Pennsylvania border to the Canadian border to the western Great Lakes.

#### *Wampum Making by European Settlers*

All persons were free to make wampum, and so European settlers in New York and New Jersey began manufacturing it in the mid 1700's (and may have done so even in the late 1600's) to meet the demand. Wampum was especially needed as a trading item to exchange with the Indians for furs. Most who made it were the wives and daughters of farmers. They used the Indian artisan's technology, i.e. an awl, bow, and gritty stone, to approximate the original wampum form (Fig. 18).

Some Bergen County, N.J., residents supplied the wampum to New York City merchants who traded it to the Indians for furs. Each person made 5–10 strings of 50 beads each/day in their homes and sold them for \$0.125/string. Wampum production in that county became a thriving cottage industry for the women, constituting the support of many poor families (Barber and Howe, 1844).

Families in the Mohawk and Hudson Valleys in New Netherlands also made wampum beads for additional income (Hagerty, 1985).

The city of Albany, in the Hudson Valley, N.Y., was one wampum manufacturing center during the last three-quarters of the 1700's and into the early 1800's. As in other sites, its production required little investment in facilities or tools, needing only small iron drills (muses), whetstones, and a supply of shells. The sources of the shells and the persons who made the beads were unrecorded (Peña, 1990).

Wampum later was manufactured in tiny factories.<sup>16</sup> One such factory, established in Passaic, N.J., in 1735, was the major supplier to Sir William Johnson for his dealings with the Iroquois from 1755 to 1775; Johnson was Superintendent General of Indian Affairs of British North America (Molloy, 1977).

In 1812, the last of the wampum factories was opened in Pascack (now Park Ridge), N.J., by the Campbell family (Fig. 19–21). Some authors (e.g. Peña, 1990)

<sup>16</sup>For the record, a wampum factory was located in Keyport, N.J.: J. Jeandron, Historian, Town of Keyport, New Jersey. Personal commun., 2001.

believe this one may have begun operating earlier. The Campbells were farmers, who operated the factory during winter, and they obtained most of their quahog shells from Jamaica Bay, N.Y. (Wilcox, 1976). Westervelt (1924) described how the Campbells obtained them: "To procure the hard shell clams to obtain from them 'black (purple) hearts' to make the valuable black (purple) wampum, necessitated a long, tedious trip by rowboat from New Milford on the Hackensack River to Rockaway, Long Island, via Newark Bay. When they returned, the live clams were placed on the ground under trees, and neighbors were invited to take all the flesh they wanted, but to leave the shells. They were carried by horse and wagon 6 miles (10 km) to Pascack. When Washington Market in New York City opened in 1812 (Brouwer<sup>17</sup>), the thrift of the Campbells was shown when they made contracts for all the empty clam shells. At stated times they went by boat to the market, and the purple hearts were skillfully broken from each shell with a small hammer and placed in barrels. They would return with 10–12 barrels at a time. They sold many of the purple hearts to the farmers' wives and daughters for miles around for making the wampum. The Campbells would purchase it from them directly and through country store dealers, who exchanged merchandise for it, and with whom the Campbells made contracts for all acquired."

Besides making wampum, the Bergen County artisans also made hair pipes and moons. Some evidence suggests, in the early years, the Campbell factory specialized in making hair pipes and moons while women in the county's cottage industry made the beads (Plate 3). By the 1800's, the women had adapted some simple mechanical devices found on their farms to make wampum, enabling them to make wampum beads much more quickly than the Indians had (Stearns, 1887). The Campbells acted as middlemen by supplying them with quahog shells and collecting their finished wampum. They also distributed whelk

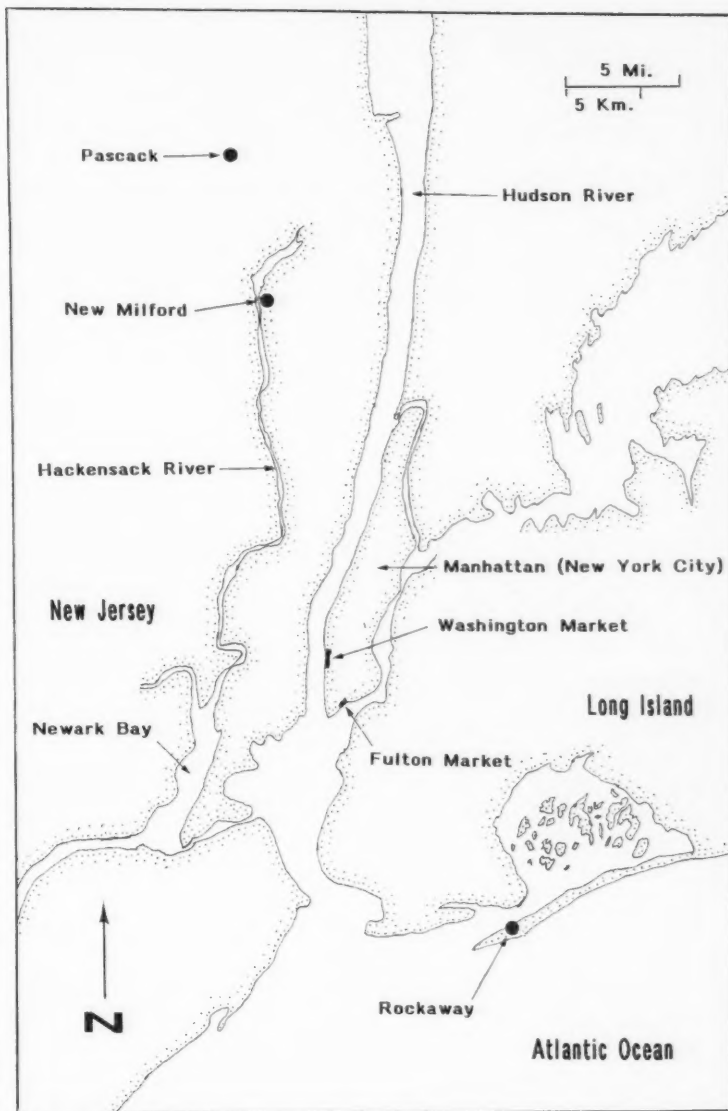


Figure 19. — Pascack, N.J., was location of wampum factory; the factory collected quahog shells at Rockaway on Long Island and also Fulton Market and Washington Market, Manhattan, N.Y. Jamaica Bay is immediately northeast of Rockaway.

shells to some groups of local women to perform the initial stages in making hair pipes and moons. The factory finished and sold them to the fur merchants.

The Campbells purchased some quahog shells from New York City's Fulton Fish Market after it began op-

eration in 1822 (the first fish stalls were present then; the first shed on the water was built in 1831 (Brouwer<sup>17</sup>). They also sponsored quahog shucking contests at Rockaway, Long Island, N.Y., in which the participants could keep the quahog meats but left the shells for the factory.

<sup>17</sup>Brouwer, N. Historian, South Street Seaport Museum, New York City, New York. Personal commun., 1999.





Figure 20.—Wampum factory at Pascack, N.J., 1860–89 (from Westervelt, 1924).

The Campbells got some queen conch shells from sailing ships coming from the West Indies which had used them as ballast (Opitz, 1995). They were brought to New York City docks, 5,000–10,000 at a time, and sold to the firm (Westervelt, 1924). Mounds of queen conch shells were numerous on islands throughout the greater Caribbean region (Stoner, 1997), and were readily available to ships' crews.

Westervelt (1924) described the Campbell factory: "The interior of a workshop resembled a lime kiln. The floors were hidden from sight by great heaps of shell, and the rude benches and tools covered entirely with flying white dust, as the shells were being ground and drilled, and suggested the application of innumerable coats of whitewash, which, in fact, it really was."

Westervelt (1924) also described how the Campbells made wampum: "The process is simple, but requires a skill at-

tained only by long practice. The intense hardness and brittleness of the shell material render it impossible to produce the article by machinery alone. It is done by wearing or grinding the shell. The first process is to split off the thin part with a slight sharp hammer. Then it is.... ground smooth on a grindstone, until formed into an eight-sided figure, of about an inch (25 mm) in length and nearly half an inch (10–12 mm) in diameter, when it is ready for boring. The drill is made from an untempered handsaw. The operator grinds the drill to a proper shape, and tempers it in the flame of a candle. A rude ring with a groove on its circumference is put on it, around which the operator (seated in front of the fastened shell) curls the string of a common hand bow. The boring commences by nicely adjusting the point of the drill to the center of the shell, while the other end is braced against a steel plate on the breast of the operator. About every other sweep of the

bow, the drill is dexterously drawn out, cleaned of shelly particles by the thumb and finger, above which drops of water from a boat fall down and cool the drill, which is still kept revolving, by the use of the bow with the other hand, the same as though it were in the shell. This operation of boring is the most difficult of all, the peculiar motion of the drill rendering it hard for the breast, yet it is performed with a rapidity and grace interesting to witness. Particular care is observed, lest the shell burst from heat caused by friction. When bored halfway, the wampum is reversed, and the same operation is repeated. The next process is finishing.... on a grindstone."

The Campbell beads were from 1/2 to 7/8 inches (12.5–22 mm) long and had a diameter of 3/16 inches (4.75 mm). Workers put them on strings 12 in (30 cm) long, each string having 50 beads; 20 strings equaled 1,000 beads. The purple wampum beads sold for \$5/thousand,



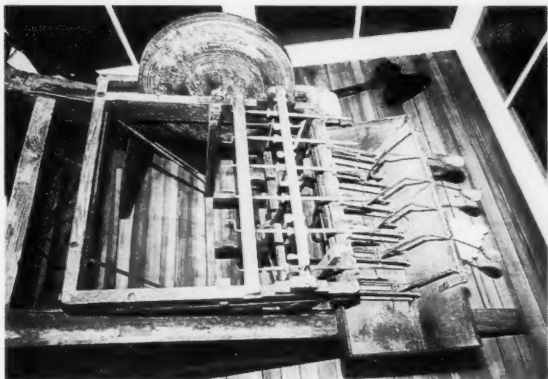
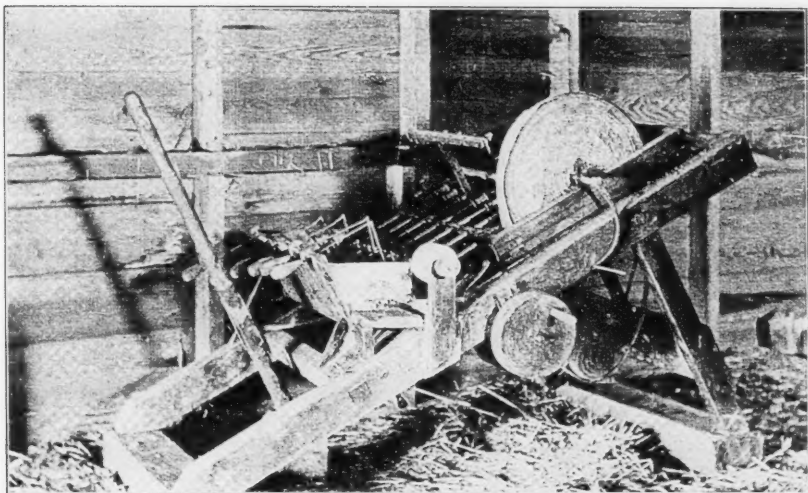


Plate 3.—Top and middle. This wampum making machine, a Campbell invention constructed in 1869, is the only one in existence. It made hair pipes from queen conch shells at the rate of 400/day. The pipes were bored half way through and then reversed in direction and the other half was bored through. It is on display at the Pascack Historical Society, Park Ridge, N.J.; Bottom, Indian with wampum moon and pipes.

while the white wampum beads sold for \$2.50/thousand (Westervelt, 1924).

The Campbell factory played an important role in the business of the American Fur Company, owned by John Jacob Astor, by supplying it with most of its wampum. Other customers were firms in Philadelphia and Texas, and United States Indian agents. The best years for the wampum makers in Bergen County were between 1835 and 1866, when the Campbells alone produced a million purple beads a year (Westervelt, 1924). (Authors' note: It would require about 885 bu of quahogs to produce a million purple beads, if 2 beads could be obtained from each shell. A bushel has no more than 300 chowder quahogs. Thus 1,200 beads could be made from a bushel of quahogs. But some large quahogs do not have purple in their shells, two beads could not be produced from every shell having a purple area, and workers must have lost some purple shells due to accidental breakage. A larger quantity of large quahogs undoubtedly was needed, but probably no more than 3,000 bu).

The industry ultimately faded. A large drop in the wampum trade occurred during the Civil War, 1861–65, and again after the Indian reservation period which began in 1870. The Campbell's factory and the remaining Bergen County wampum-making industry continued their operations part-time until they went out of business in the 1880's. Another wampum factory near Nyack, N.Y., on the Hudson River had closed its operations in about 1875 (Hagerty, 1985). The Campbells had been part of a widespread cottage industry in the county which had lasted for more than a century (Westervelt, 1924).

In 1888, Robert Campbell, a family member, reported that a lack of shells contributed to the decline. By the 1880's, changing tastes in quahog consumption had led to a scarcity of large chowder quahogs with purple edges. People had begun to eat large quantities of littlenecks leaving few quahogs available to grow to chowder size. Campbell said, "The best beads are made from clam shells—common round clams, as they call 'em down east; but the little neck business has spoiled that branch of the trade.... You

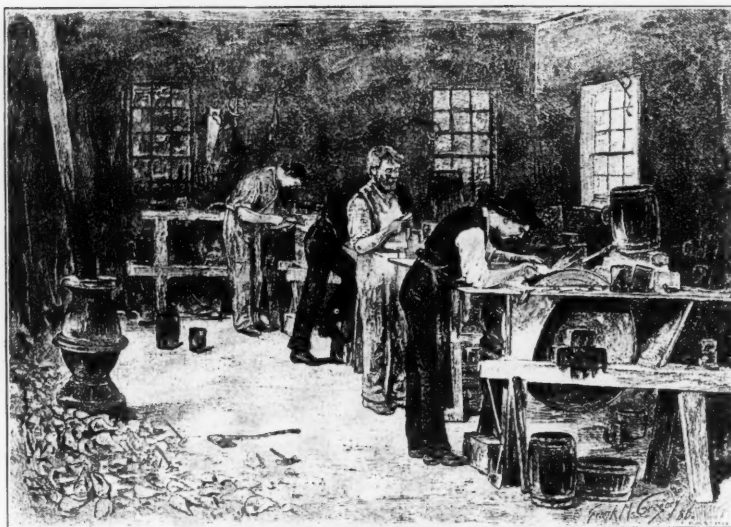


Figure 21.—Wampum makers in Campbell Company plant, Pascack, N.J., sometime between 1735 and 1899 (from Westervelt, 1924).

see, the Indians have a fancy for beads that are part purple and the correct color can only be found in the j'ints of old clam shells. Now, there ain't no special call for old clams in the market. Everyone wants the youngest clams they can get, and they are all called 'littlenecks.' Anyhow, we can't get enough old clam-shells now to pay for the working. They've all died out, and the young-uns ain't allowed to grow up. Why, sir, poor as Indians is, I could sell five thousand dollars worth of bead wampum every year if I could get the clam shells" (Westervelt, 1924).

#### *Wampum, An American Heritage*

Some shell beads are manufactured today, but gem stones and glass imitations are the most important jewels. Nevertheless, among the Iroquois, wampum beads, though scarce outside of museums, are still a vital part of traditional ceremonies (Wilcox, 1976).

Wilcox (1976) wrote, "It must be recognized that wampum is very much a part of the traditional heritage of white America, and cannot be considered a monopoly of the Iroquois or other Indian groups. After all, wampum was legal currency in the colonies for nearly half a century. Wampum is therefore a truly "American"

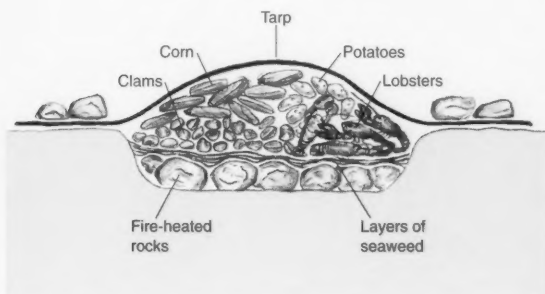
heritage. While it functioned within the traditional ideologies of both the white man and the Indian, the industry itself was a particular function of the cultural and personal interactions between these two peoples."

#### **History of New England Clambakes**

This section on the history of clambakes is largely abstracted from a book entitled, *Clambake a History and Celebration of an American Tradition*, written by Neustadt (1992). A classic clambake is unique because no other meal anywhere in the world is similarly prepared (Boisvert, 1993) (Plate 4). It has three essential ingredients: firewood, heated rocks, and rockweed, which separates the food from the heat and makes the steam which cooks the food (Neustadt, 1992), and it is prepared in a shallow pit on a seacoast beach. During the 1800's and 1900's, the most important shellfish used in clambakes were softshell clams to be eaten steamed, while quahogs were included to be eaten raw on the half-shell and as an ingredient in clam (quahog) chowder.

After examining the archaeological evidence, Neustadt (1992) is not sure the prehistoric New England coastal Indians cooked softshells and other seafood

Plate 4.—A clambake. Left, classic clambake ingredients (NMFS illustration by D. Stanton); Right, Taking out "the bake."



on beaches using hot rocks for heat and rockweed or other seaweeds for steam. It has been assumed the Indians taught the Pilgrims how to prepare clambakes like this and the method was passed along unmodified to the present day, but Neustadt believes a more rudimentary form of the clambake probably originated in the Indian culture, but it was developed to its present forms by the colonists.

Neustadt (1992) describes an Indian method of cooking quahogs on Nantucket, Massachusetts, in the late 1700's, which provides evidence that a rudiment of the modern clambake did originate in the Indian culture: "The quahogs were placed upon bare ground, side by side, with their mouths biting the dust. The burning coals of the camp-fires... were... applied plentifully to the backs of the quahogs. In a few minutes after the application of the fire, the cooking was declared to be at an end, and the roasting of quahogs complete. The steam of the savory liquor, which escaped in part without putting out the fire, preserved the meat in a par-boiled state, and prevented it from scorching, or

drying to a cinder, and the whole virtue of the fish from being lost. The ashes of the fire were effectively excluded by the position in which the animal was placed at the beginning; and the heat has completely destroyed the tenacity of the hinge which connected the shells." A replica of this method used by Long Island Indians is housed by the Garvies Point Museum and Preserve in Glen Cove, N.Y. (Fig. 22). This one has rocks lining the base of a shallow pit about 75 cm across. The rocks were heated by a fire and then the quahogs were placed on top of them to be cooked.

#### 1800's Clambakes

Clambakes were concentrated in New England, but they were also held in greater New York City and the Philadelphia area (Neustadt, 1992). They could take many forms and be situated in different settings (Fig. 23, 24). The first recorded traces of clambakes began to appear in the popular press in the early 1800's. At that time, they were small-scale private parties, on the level

of "the grange meeting, a social at the local school house, a country dance, the Fourth of July picnic, the annual county fair, the coming of the circus—the main events, according to Dulles (1965), of rural American cultural life" (Plate 5). By mid century, the small-scale bakes were becoming larger and grew into large-scale public and commercial activities (Plate 6). Thursday was the common day on which clambakes were held.

But by the end of the 1800's, "well-integrated into the activities and symbols of 'authentic' New England traditions, the clambake had become a part of the essence of America and Americana, along with Thanksgiving, the Fourth of July, barbecues, and apple pie" (Neustadt, 1992). It had become an institution in many parts of New England helped along by a context for leisure that had developed in the country. "The growth of tourism; the propagation of public dining, commercial eating establishments, and popular amusements; and the establishment of summer resorts and seaside communities that resulted, constituted

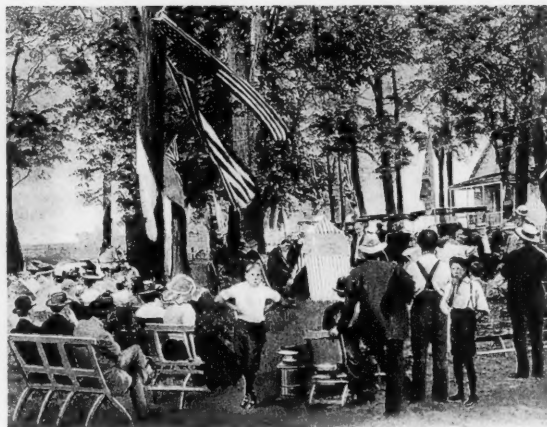
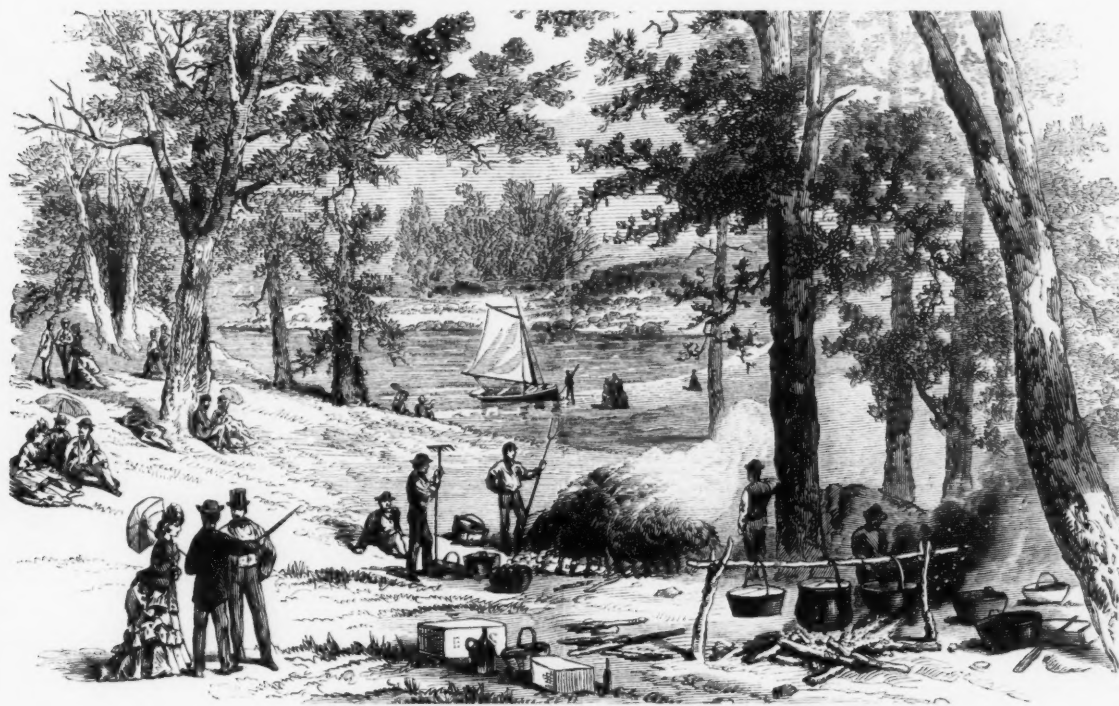


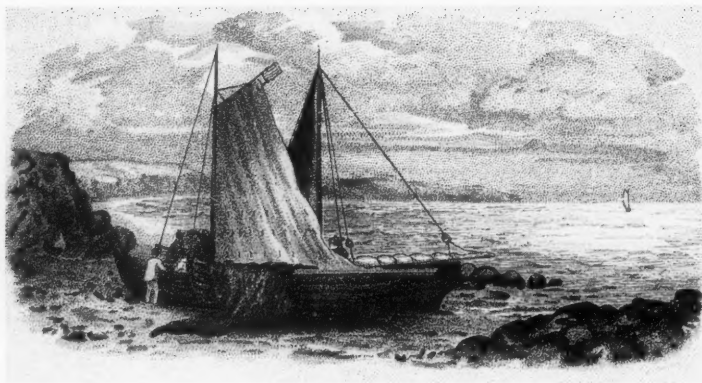
Plate 5.—Early clambake scenes, large and small. Top left, U.C.T. clambake, Springfield, Conn.; top right, at Fort Iconderoga, N.Y. (ca. 1908); middle, small-scale clambakes (preparing the clambake on the left and opening up the clambake on the right); bottom, a family clambake.





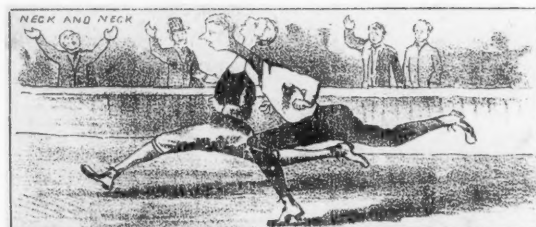
Plate 5. — (cont.) Above, at the Rhode Island Clambake Club (ca. 1879); below, a Round Island, Conn., clambake (ca. 1871).





GET A  
GENUINE RHODE ISLAND DINNER  
—AT THE—  
**New Nantasket Clam Bake,**  
*Near Rockland Cafe.*  
The Pleasantest Dining-Room on the Beach.  
Served in Rhode Island Style  
From 12 M. to 8 P. M.

**Clam Chowder, Baked Clams**  
**Drawn Butter Dressing,**  
**Clam Fritters, Baked Blue**  
**Fish, Baked Cod, Fried Perch,**  
**Boiled Potatoes, Sweet**  
**Potatoes, Green Corn, Water**  
**Melon, Cucumbers, Pickles,**  
**Radishes in their season,**  
**Brown and White Bread,**  
**Tea or Coffee.**  
**Tickets, 50 Cents.**



**CLAM BAKE AND FISH DINNER.**  
**VINE CAFE,**  
Sagamore R. R. Station, NANTASKET, BEACH.

## WOOD'S OCEAN COTTAGE

### RHODE ISLAND CLAM-BAKE

and FISH DINNERS,  
EVERY DAY FROM 11 A. M. TO 8 P. M.

#### BILL OF FARE.

Clam Chowder. Baked Clams, on rocks, with  
Melted Butter. Clam Fritters. Baked Blue  
Fish. Fried Perch. Fried Cod. Baked Potatoes  
\*Cucumbers. \*Green Corn. Chips.  
Brown and White Bread. \*Water-melon. Tea  
and Coffee. \*IN SEASON.

#### DINNER 50 CENTS.

Meals served to order. Board by  
Day or Week.

**MRS. W. K. WOOD.**

Pioneer & Original Clambaker of Nantasket Beach.  
(Late of Ocean House.)

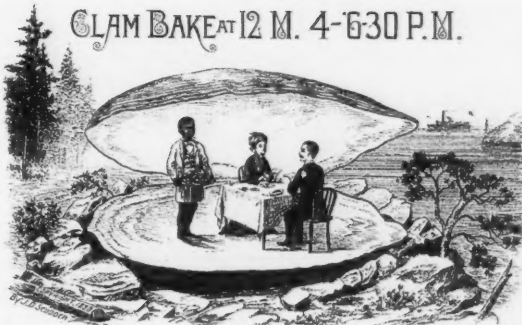
**Ye Old Fashioned CLAM BAKE \$1.00**

Served from  
Noon to Midnight.

**FELTMAN'S CONEY ISLAND.**

Plate 6.—Typical early clambake advertisements, some with bill of fare on back.

## CLAM BAKE AT 12 M. 4-630 P.M.



Fourteenth  
Annual Season.

The Pioneer and only original  
Genuine Rhode Island

### CLAM BAKE DINNER.

On Nantasket Beach.

EVERY DAY from 12 M. to 7 P. M.,

—AT THE—

### OCEAN HOUSE.

**BILL OF FARE.**

CLAM CHOWDER,  
BAKED CLAMS,  
(old style broiled oysters, with melted butter dressing).  
BAKED BLUE FISH,  
BAKED POTATOES,  
CLAMS FRIED IN BATTER,  
\*BAKED SWEET POTATOES,  
\*GREEN CORN, \*CUCUMBERS,  
\*CHILLED WATERMELONS,  
\*In their Season.  
BROWN AND WHITE BREAD, &c.

**Dinner Tickets, 50 cts.**

Ocean House Dining Room  
seats 500 at one sitting.

WM. K. WOOD,  
PROPRIETOR.

## Clam Bake, DAILY,

—AT THE—

### Arlington House,

NEAR SAGAMORE HILL,  
NANTASKET BEACH.

Two minutes walk from Station.

Dinner from 12 A. M. to 9 P. M.

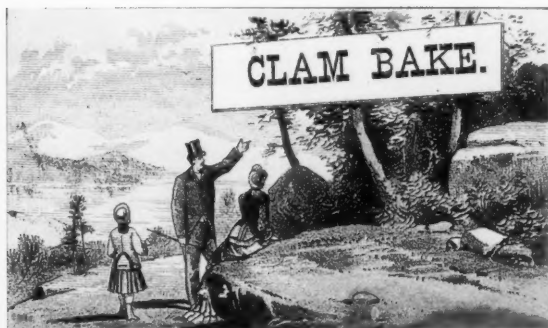
#### BILL OF FARE.

Baked Clams, with butter dressing,  
Clam Chowder, Fried Perch,  
Baked Bluefish, Nantasket Chips.  
Clams in Batter, \*Sweet Potatoes,  
\*Green Corn, \*Chilled Melons,  
Tea, Coffee and Bread.  
\*In their Season.

**DINNER TICKETS, 50 CENTS.**

Children under 10 years, half price.

S. CHESSMAN & CO.



## MELVILLE GARDEN,

DOWNER LANDING, . . . BOSTON HARBOR.

OPEN EVERY DAY EXCEPT MONDAY.

One of the Finest Harbor Resorts in New England.

The Garden contains FIRST-CLASS RESTAURANT, BOWLING and SHOOTING ALLEYS, BILLIARD TABLES, PATENT SWINGS, FLYING HORSES, CAMERA OBSCURA, MENAGERIE, BEAR PIT, &c. Row Boats and Yachts to let.

RHODE ISLAND CLAM BAKE at 12, 4 and 6.30 o'clock. DINNER TICKETS, 50c.

EDMONDS' BAND, DAY AND EVENING.

The Garden will be Illuminated Every Evening with 20 Electric Lights  
Grand Concert by Edmonds' Band Every Sunday Afternoon and Evening.

HINGHAM STEAMERS LEAVE ROWE'S WHARF at 5.45, 9.15, 10.30, 11.30, 12.30, 2.30, 3.30, 5.30, 6.30, 7.45 and 9.30. RETURNING, LEAVE DOWNER LANDING at 7, 7.30, 9.45, 10.30, 12.15, 1.15, 4, 5.15, 6.45, 10.30, 12.30. CROSS TRIP to and from NANTASKET BEACH. Leave Downer Landing at 11.30, 12.20, 1.30 and 4.30. Leave Nantasket Beach at 9.30, 10.15, 1, and 4.30.

SUNDAYS. Boston to Downer Landing at 10.15, 1.15, 6.45, and 7.15. Downer Landing to Boston at 12, 2.30, 4, 9.30. \*Mondays excepted. \*Saturdays excepted.

BUY THE EXCURSION TICKET at Rowe's Wharf, 60 Cents. (over)

the backdrop against which the clam-bake reached the apex of its popularity, captivating both the popular imagination and the public appetite" (Neustadt, 1992). Narragansett Bay innkeepers had found clambakes enticed city dwellers to the shore. Thousands came by railroad, trolley-car, and steamer. Most large hotels put on weekly clambakes (Boisvert, 1993).

Neustadt (1992) continues, "Clambaking appears as an ongoing commercial enterprise in New England in the middle of the 1800's. During the same period the railroad route was being completed between New York and Boston—the country's two major cities and the source of most of New England's visitors—Rocky Point was

established as a resort in Rhode Island (Fig. 25). Catering to wealthy tourists steam boating from nearby Providence, it became renowned for its clambakes, which soon bore the title, 'the genuine Rhode Island shore dinner.' *Appleton's Illustrated Handbook of American Travel* from 1860 characterized it as 'a wonderful summer retreat among shady groves and rocky glens.... In the summer-time half a dozen boats ply, each twice a day, on excursion trips down the bay, charging 25 cents only for the round voyage. Hundreds come here early and feast upon delicious clams, just drawn from the water and roasted on the shore, in heated seaweed, upon true and orthodox 'clam bake' principles. Let no visitor to Providence fail to eat clams and chowder at Rocky Point, even if he should never eat again.' " This success fixed the association of the clambake with the State of Rhode Island, and the first mention of a clambake to appear in an American cookbook referred to it as "A Rhode Island clambake." This shore dinner continued to be a prominent feature of Rhode Island's summer culture throughout the rest of the 1800's, and Rocky Point continued as its reigning star into the 1900's (Neustadt, 1992).

Small, seaside resorts were developed for eating and swimming. Some had a small pavilion, but they all had out-of-doors tables and seats, and a beach. People got to them on "dirt" roads through the woods that surrounded the site on the edge of the water. The clambakes held at them were noted for their informality. The tables were long wooden planks set on wooden sawhorses and covered with white butcher paper (Plate 7). The seats were long wooden planks mounted on short wooden sawhorses (Boisvert, 1993). The ingredients for a clambake for each person includes a white potato, one-half a sweet potato, an ear of corn, a small onion, a precooked sausage link, a piece of fish, about 30 steamer clams, a lobster, a large piece of watermelon (Heisler, no date), six littlenecks or cherrystones on the halfshell, and a bowl of quahog chowder (the chowder occasionally was made with meats of quahogs and steamer clams in equal amounts) (Boisvert, 1993).

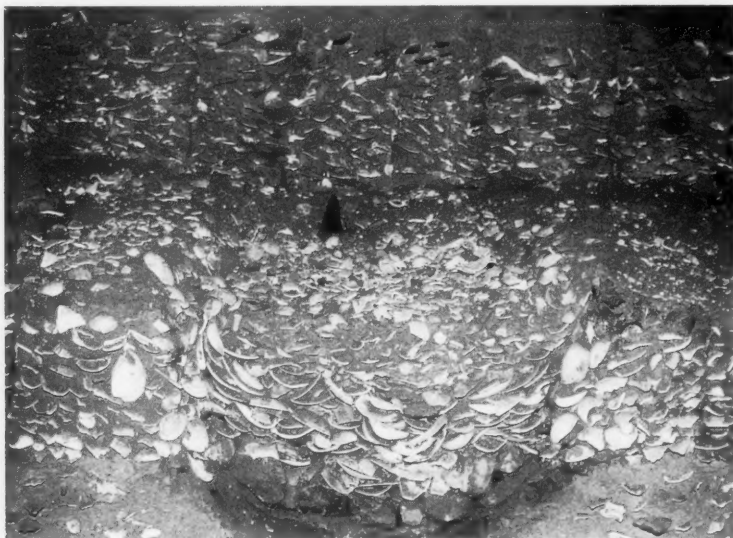


Figure 22.—Prehistoric hearth of Massapequa Indians on Long Island, N.Y. Bottom of pit was lined with rocks to retain the heat of fire used in cooking the quahogs.



Figure 23.—An eating establishment called "Cedar Jacks," located on the Harlem River, near 163rd Street, New York City (Copyright collection of The New-York Historical Society).



In the New Bedford, Massachusetts area, many advertisements for clam-bakes appeared in print. Lincoln Park, an amusement center which opened in 1893 near New Bedford, had its own clambake pavilion which served two bakes a week, with hundreds of people at a sitting. Neustadt (1992) continues, "At the same time that increasing numbers of people were gaining access to commercial pavilions, the clambake began to appear in literary and visual display. In the popular media, clambaking became emblematic of a range of themes—of American origins and originality; of the New England region itself; and of Yankee temperament, which was genuine and full of vigor, in body as well as spirit."

#### *1900's Clambakes*

The typical foods in a 1900's clambake continued to be softshell clams, white and sweet potatoes, onions, corn-on-the-cob, bluefish or mackerel fillets, quahog chowder, and for dessert, watermelon. All the foods, except the chowder and watermelon, are usually held in individual fine-mesh cloth bags. Littlenecks and cherrystones, both raw on the half-shell, as appetizers and lobsters have also been included in many clambakes.

Many small clambakes initially were held at seacoast beaches for private parties and families and many still are. The male members of a gathering dug a shallow pit about 1.5 m across in the sand, laid rocks perhaps 15–20 cm in diameter in it, and spread kindling and firewood over them. The wood was set afire and left to burn for about an hour heating the rocks. The charred wood was then removed. Next, rockweed in a layer 15–45 cm thick was laid over the hot rocks. The men set cheesecloth bags of food in the rockweed, piled another layer of rockweed over the food, and finally placed a tarpaulin sheet over the pit to retain the steam. The food was cooked in the steam and was ready to eat after 2–4 hrs. Late in the century, crews preparing large-scale clambakes commonly cooked the same foods on stoves (Neustadt, 1992).

The number of clambakes began to decline after the Hurricane of 1938 destroyed most of the small resorts where clambakes were held along the New

England coast. A few survived, but the 1930's Depression and World War II put most of them out of business and the Hurricane of 1954 finished off the rest. But the intensity felt and a yearning for

the past associated with the clambake continued as an "ancient New England rite" (Neustadt, 1992).

In recent decades, businesses have formed which cook the foods eaten



Figure 24.—Top: Getting ready for a clam bake, Orr's Island, ME. Middle: Clambake at Field's Point, Narragansett Bay. Bottom: Opening clam bake at Little Diamond Island, ME.



in clambakes. They put on clambakes wherever a group wants them—on a beach, in their yard, or in a hall. The foods are steamed in large metal woks, with neither rocks nor seaweed. The businesses bring the foods and cooking woks to the sites in trucks and their crews cook and serve the traditional foods. Besides, at least one company offers a ready-to-cook clambake package, which can be shipped anywhere in the United States (Neustadt, 1992).

In articles produced by the current popular media, the positive features of clambakes help to epitomize summer in New England. Photographs of the bounty of the clambake illustrate tourist brochures and direct-mail catalogues. Clambakes have also become the public relations extravaganza of choice for commemorating annual meetings, anniversaries of various kinds, and political events. Clambakes also inspire feature articles in *Yankee Magazine* and similar publications. At least one how-to clambake book and a video have been published, and, in parts of coastal New England, magazines and newspapers are littered with favorite pre-bake chowder recipes in the summer (Neustadt, 1992).

Neustadt (1992) wrote, "With each new bake, the past is brought into the present, to be relived and re-experienced in the reenactment. By getting people... to eat foods untouched by culture and cuisine and cooked without utensils, the clambake celebrates nature unencumbered by societal and cultural constraints." As is true with wampum, clambakes are an "American" heritage.

#### Development of the Quahog Fishery

Belding (1912) believed quahogs have been eaten by people of European descent for as long as the Europeans have occupied North America. The English-speaking settlers of the Maritime Provinces and most of New England south to Rhode Island took the Indian name

Figure 25.—Top: Getting ready for a clam bake, Rocky Point, R.I. Bottom: U.S. President Rutherford B. Hayes and party at Rhode Island clambake, 28 June 1877, Rocky Point, R.I.

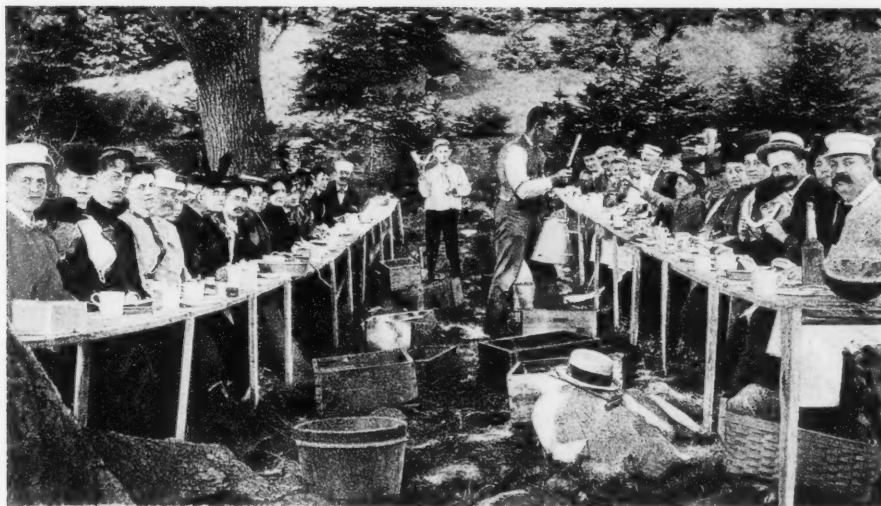


Plate 7. — A Squirrel Island, Maine, clambake showing the table arrangement.

"quahog" for the *M. mercenaria* they found, and used "clam" for the abundant *Mya arenaria*. English immigrants, who settled the coasts from Connecticut to Georgia, termed *M. mercenaria*, "clam," a common name for burrowing bivalves in Britain (Edwards, 1997). The softshell clam was far less abundant west and south of Rhode Island and so there was little need to distinguish the two species by name.

European colonists likely harvested quahogs in the shallows by treading and using short rakes. Afterward, there was a progression of harvesting gears, which first permitted clamming in deeper beds and later mechanized harvests. After short rakes came hand tongs, then basket rakes, bull rakes, mechanical tongs, rocking chair dredges, hydraulic dredges, and finally hydraulic escalator dredges, and others. Each gear, even the short rake, was improved through time as increasingly efficient designs were made and as steel replaced iron in rakes, aluminum replaced wood for handles, and as engine-powered pumps and hoists, better hoses, conveyor screen belts, and outboard motors became available for use on boats.

Before World War II, most quahogging boats were 3–5 m long, and they were propelled with oars. Afterward, outboard motors replaced oars. The first

motors had 5–7 hp; their gasoline tanks were filled by hand. The motors' power has since increased substantially to their present 75–225 hp, while their sizes and weight increased only 2–3 times. Gasoline is fed to an engine through a hose leading from a portable 1.5–10 gallon tank set on the deck of the boat. Lightweight but strong 5–6.5-m long fiberglass hulls, which required little maintenance, eventually replaced most wooden hulls. Other developments that made it easy to transport the boats to harvesting areas and take them home every afternoon were the developments of sturdy boat trailers and pickup trucks.

The long life span of quahogs (as much as 46 yrs) coupled with their relatively slow growth allow sets of juveniles to remain harvestable as littlenecks (17/8–2 1/4 inches long) and cherrystones (2 1/4–3 3/4 inches) for several years in the north part of the range. Quahog stocks therefore tend to be more stable than other commercial mollusks, such as bay scallops and softshells. Fishermen have long relied on quahogging to provide seasonal employment, while others who have been caught without a job or those desiring additional income have used it as an income alternative or supplement.

The quahog fishery has been easy to enter for treaders, rakers, and tongs, be-

cause gear is inexpensive, boats often are borrowed from other fisheries, and only modest skills are required for harvesting. Newcomers can simply follow established fishermen to the beds, observe their procedures, and harvest nearly as many quahogs. The main requirements for a good harvest are strength and determination.

During the present century, northern states, mainly from Massachusetts through New Jersey, have produced far more northern quahogs than southern states, Maryland through Florida (Table 5). The leading producers in the north historically have been New York, New Jersey, Massachusetts, Rhode Island, and, recently, Connecticut, while Virginia and North Carolina have led in the south (Tiller et al., 1952; O'Bannon<sup>18</sup>). Florida landings were substantial in the 1980's and 1990's. Some of the Florida landings include southern quahogs and hybrids between northern and southern quahogs.

Total quahog landings, Maine through Florida, were about half as large in 1997 as in 1950, and, in 1997 landings declined from what they had been earlier in the

<sup>18</sup>O'Bannon, B. NMFS Fisheries Statistics and Economics Division, Silver Spring, Maryland. Personal commun., 1999.

Table 5.—Landings in bushels of northern quahogs, *Mercenaria mercenaria*, by state, 1900–02, 1950, and 1997 (Source for first two periods: Anderson and Peterson, 1953; source for 1997: Fisheries Statistics and Economics Division, National Marine Fisheries Service, NOAA, Silver Spring, Maryland). Multiply landings values by 1,000. The landings in some, if not all, states in 1997 do not include quahogs produced by hatchery-grow-out operations.

| State               | 1900–02 | 1950  | 1997            |
|---------------------|---------|-------|-----------------|
| Maine               | —       | 50    | 1               |
| Massachusetts       | 78      | 183   | 89              |
| Rhode Island        | 18      | 204   | 69              |
| Connecticut         | 13      | 1     | 108             |
| New York            | 123     | 643   | 351             |
| New Jersey          | 472     | 565   | 188             |
| Delaware            | 1       | 90    | 5               |
| Maryland            | —       | 34    | 5               |
| Virginia            | —       | 241   | 120             |
| North Carolina      | 120     | 86    | 92              |
| South Carolina      | 28      | 1     | 34              |
| Georgia             | 1       | —     | 2               |
| Florida, East coast | 1       | 86    | 67 <sup>1</sup> |
| Florida, West coast | —       | 1     | 49 <sup>2</sup> |
| Totals              | >855    | 2,185 | 1,180           |

<sup>1</sup>11.5% of this total was from seed reared initially in hatcheries.

<sup>2</sup>99.6% of this total was from seed reared initially in hatcheries.

1990's and in the 1980's (O'Bannon<sup>18</sup>). A large part of the decline in landings after the 1970's resulted from precipitous production declines in New York's Great South Bay and New Jersey's coastal bays (Barnegat Bay, Little Egg Harbor, and Great Bay). The decline would be even larger had it not been for the development of hatchery-growout culture of quahogs along the Atlantic Coast in the 1980's and 1990's. The 1997 landings totals include those reported from wild beds but some landings from hatchery-growout beds are not included.

During the late 1990's, quahog supplies became scarcer in Connecticut and New York beds, but probably they did not in Rhode Island, another area of quahog production decline (Valliere<sup>19</sup>). A major factor in Rhode Island instead has been a reduction in the numbers of quahoggers due to the strong U.S. economy and high employment rate on land in the 1990's. Many quahoggers historically have left the beds whenever jobs have been plentiful ashore, while the reverse has been true during periods of recession.

The industry initially handled quahogs in second-hand flour and sugar barrels.

<sup>19</sup>Valliere, A. State of Rhode Island Fish and Game Department, Wakefield. Personal commun., 1999.

The barrels had holes in their sides and bottom to allow air circulation and to release any water. The barrels along with burlap bags were used at least as late as the 1940's (Tressler and Lemon, 1951). Since then, the industry has handled quahogs in bags and wooden baskets. A bushel of quahogs weighs 75–80 lb. A bushel contains about 750 littlenecks (about 10 littlenecks make a pound).

The approximate yield in pounds of quahog meats in a U.S. standard bushel of quahogs varies by state; the poundage is slightly higher in the north than the south: Maine, 10; Massachusetts, 11; Rhode Island, 12; Connecticut, 12; New York, 8; New Jersey, 9; Delaware, 10; Maryland, 5.7; Virginia, 5.7; North Carolina, 7.7; South Carolina, 8; Florida, east coast, 8 (Anderson and Power, 1949). In recent years, the industry handles quahogs by the piece rather than by the bushel. They are sold in various outlets such as fish markets (Fig. 26), supermarkets, restaurants, and roadside retail stands (Fig. 27).

State and local regulatory agencies have limited quahog harvesting effort to conserve and stabilize stock abundances by placing restrictions on the gear types and harvesting times. Most regulations have been implemented since the early 1900's. In many areas, only hand rakes or tongs are allowed in the public fishery (which comprises the vast majority of harvest grounds in most states except Connecticut), although several states allow mechanical harvesting in some

| CLAM PRICES     |        |         |
|-----------------|--------|---------|
| Top Little NECK |        |         |
| 3.00            | 2.00   | 2.40    |
| Per Doz         | Per 50 | Per 100 |
| CHERRY STONE    |        |         |
| 2.50            | 1.80   | 1.60    |
| Per Doz         | Per 50 | Per 100 |
| CHLORIDE        |        |         |
| 2.00            | 1.60   | 1.20    |
| Per Doz         | Per 50 | Per 100 |

Figure 26.—Sign in fish market, Barnegat, N.J., lists selling prices of quahogs, 1998. Photograph by C. L. MacKenzie, Jr.

public grounds. Some localities, such as Massachusetts and North Carolina, limit the daily quantity a fisherman or boat can land each day.

#### Early Quahog Commerce

Commercial quahog production did not become substantial until the late 1880's and perhaps the early 1900's (Tressler and Lemon, 1951), when oysters were being eaten in large quantities throughout the eastern United States



Figure 27.—Quahogs (clams) are sold in some roadside stores such as this one on the eastern shore of Virginia, 1998. Photograph by C. L. MacKenzie, Jr.



(Plate 8). Oysters were commonly eaten raw on the half-shell, but they were available mainly in the colder "R" months (September through April) and less in the summer. The *Fishing Gazette* (Anonymous, 1897) and Belding (1912) believed the demand for littlenecks arose to fill the summer gap for a raw shellfish to be eaten on the half-shell.

Littlenecks were a good size for a flavorful mouthful, and they were tender, in contrast to the chowder quahogs which are flavorful, but too large and tough to chew easily. Belding (1912) reported the increasing popular demand for littlenecks spurred rapid development of the quahog industry, thereby providing employment for hundreds of fishermen and giving the quahog importance as a seafood. Besides fishermen, many farmers in coastal towns, at least from southern New England (MacKenzie, 1992b) through New Jersey (Sim, 1949), were part-time quahog diggers during their slack periods.

New York City was the principal quahog market. The dealers received most of the oysters and quahogs on barges tied along wharves in the East and Hudson Rivers, selling oysters during the cold months and quahogs during the warm months (Fig. 28). At least five times as many oysters were sold as quahogs. In the 1870's, the city's wholesale and retail trade for quahogs and softshell clams was estimated at \$600,000, with quahogs being by far the more important (Ingersoll, 1887).

About 100 sailing boats carried quahogs from various bays to the city, with an average cargo of about 350 bu. Perhaps 20 additional boats supplied quahogs to towns along the Hudson River. The principal quahogging grounds were in Raritan Bay, N.Y. and N.J.; Barnegat Bay, N.J.; and Great South Bay, Cow Bay, and Little Neck Bay on Long Island, N.Y. Some quahogs also came from the Chesapeake Bay area. Including everyone involved—fishermen, retailers, and street peddlers—the quahog trade employed about 8,000 people. The city quahog merchants handled other fish products as well, and all the oyster merchants sold quahogs (Ingersoll, 1887).

The New York City wholesale dealers conducted their business by contracting

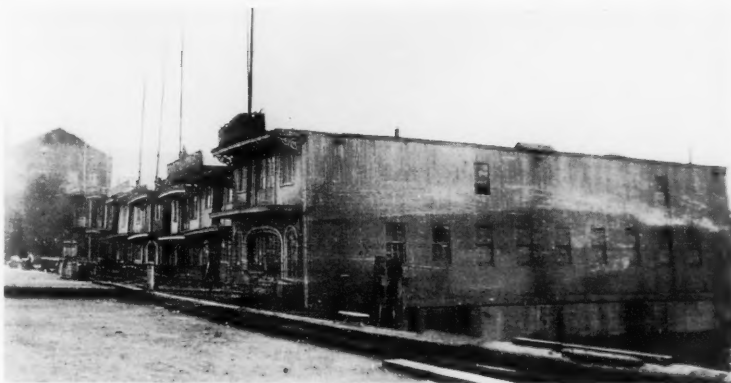


Figure 28.—Barges tied on Manhattan Shore, East River, N.Y. They handled mostly incoming oysters, *Crassostrea virginica*, but also quahogs (Copyright collection of The New-York Historical Society).



Figure 29.—Street peddlers in Italian district of Manhattan, N.Y., selling Quahogs. Peddler is opening a quahog while customer eats a raw quahog on the half-shell, circa 1924 (From Milstein Division of United States History, Local History and Genealogy, The New York Public Library, Astor, Lenox and Tilden Foundations).

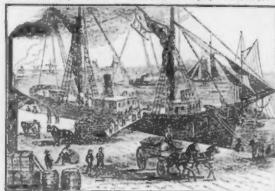
with their customers to supply a certain quantity of quahogs at appointed times. With an order from a dealer, a boat captain sailed to one of the quahog grounds, where he purchased the quahogs from fishermen and returned to the market. There he found the dealer with his horses and wagons ready to receive his quahogs. The dealer delivered the quahogs to retailers and peddlers who purchased them by the thousand (Ingersoll, 1887). Figures 29–31 show New York City street peddlers selling quahogs from push carts, and Figure 32 depicts a quahog peddler

and his horse and wagon and his peddling cry. Peddlers sold quahogs and a myriad of other goods off push carts in many east coast cities at least as far south as Savannah, Ga.

Ingersoll (1887) continued, "In addition to this, many clams were brought into New York by (horses and) wagons from Long Island. This is still the case in respect to both hard and soft kinds. A considerable trade was then in existence in clams salted and pickled for the European steamships and the interior of the U.S. There was also an inland commerce



NOTE: We do not receive delivery in advance of goods. It ships and takes receipt "in good order" and they are at your risk after that receipt is signed by the Transportation Company. We are your guaranty, if there is any loss or damage, it could be recovered, if possible, before you ship a receipt, and in any case you should make your claim on the Transportation Company without delay, and not upon us, as it is positively beyond us to allow for loss.



ESTABLISHED 1876  
 BOUGHT OF  
**Edgar J. Thomas**  
 WHOLESALE DEALER IN  
 Fancy Fruits, Nuts, Produce, &c  
 248-250-252 S. FRONT ST.  
 TERMS WEEKLY.

1366 Pa Oysters  
 500 Clams

500  
 450 10 50



New York Jan 20 1907  
 H. J. Empire State

Oysters put up for Shipping.  
 Stock, standards, Packed, Bins and Families  
 OYSTERS.  
 Of the following class descriptions, viz:  
 SHALLOO ROCK, WELL PACKED,  
 EAST OYSTERS, FRESH BY  
 SATISFIED, CHESAPEAKE, etc.  
 Also the famous CLAMS, hard and soft shells.  
 Also the famous CLAMS, hard and soft shells.  
 Also the famous CLAMS, hard and soft shells.

Bought of A. & M. Dorlon,  
 OYSTER STANDS, 11 & 13 FULTON MARKET.

Jan 26 150 Frying Oysters 17 225  
 125 Pick " 14 155  
 300 Steaming " 57 185  
 100 Clams " 14 50  
 28 150 Frying " 17 225  
 125 Pick " 14 155  
 300 Steaming " 57 185  
 100 Clams " 14 50  
 30 150 Frying " 17 225  
 125 Pick " 14 155  
 300 Steaming " 57 185  
 100 Clams " 14 50  
 A. & M. Dorlon 17 50

Plate 8.—Purveyors of quahogs: Stores, restaurants, and fish dealers.



Figure 30.—Street peddlers in Italian district of Manhattan, N.Y., selling quahogs, circa 1936 (From Milstein Division of United States History, Local history and Genealogy, The New York Public Library, Astor, Lenox, and Tilden Foundations).

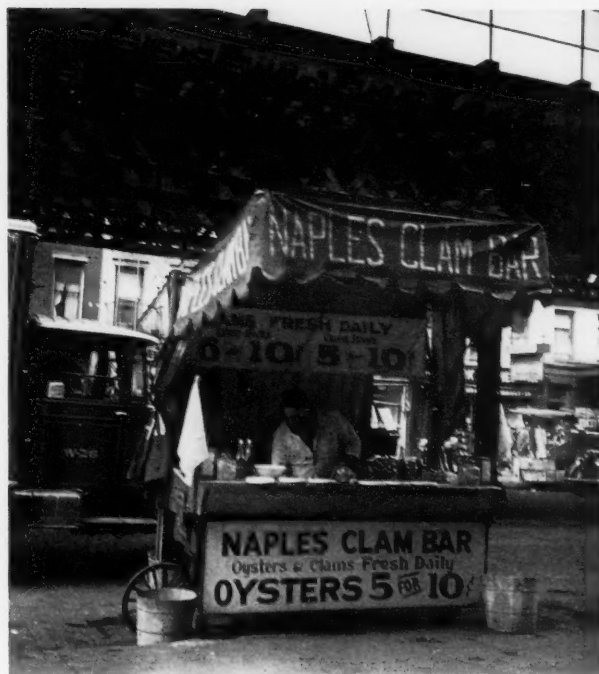


Figure 31.—Mobile clam and oyster bar, Manhattan, N.Y., 1937. Photograph by G. Herlick, Museum of the City of New York print archives.

(still continued) in quahogs, packed in ice or preserved in vinegar in the manner of oysters, since immigrants have taken to the prairies the taste for the fry, the fritter, and the chowder, perhaps because they find in their salt flavor the best reminder of the early home by the seaside."

For at least 60 years, from the late 1870's (Ingersoll, 1887) through the mid-1930's, nearly all the quahoggers who dredged by sail in Raritan Bay sold the quahogs to "buy-boats" from New York City and other ports such as Newark, N.J. The buy-boats usually made their purchases on Wednesdays and Fridays. The boats traveled between the cities and the bay when the water currents were favorable, i.e. either incoming or outgoing currents; winds, and in later years small motors, were rarely strong enough to push the boats against strong water currents. Motorboats that had to run to New York City against a falling

Hudson River tide went up the river close to either shore where currents were slowest (Unger<sup>1</sup>).

To keep their expenses at a minimum, the fishermen used secondhand potato, onion, or feed sacks to hold their quahogs. Beginning in the late 1930's, trucks gradually took over the transport of quahogs from Raritan Bay and other bays, and the water transport ended. The truckers arrived at the docks in the afternoon, fishermen lifted the quahogs onto the docks and into the trucks, while the driver kept track of the quantity loaded (MacKenzie, 1992a). For many years, buy-boats presumably also brought quahogs to New York from Long Island bays before trucks took over the transport.

Since the late 1880's, quahogs have been sorted by shell size (Table 6) in response to market demand (Ingersoll, 1887). The smallest size has been called "littleneck," the next larger size

Table 6.—Approximate size ranges (in inches) of various categories of quahogs used in the trade during the 1910's, mid 1990's, and late 1990's.

|             | 1910's <sup>1</sup> | Mid 1990's <sup>2</sup> | Late 1990's <sup>3</sup> |
|-------------|---------------------|-------------------------|--------------------------|
| Littleneck  | 1 1/2–2 1/4         | 1 7/8–2                 | 1 7/8–2                  |
| Topneck     | 2–2 1/8             | 2–2 1/8                 | 2–2 1/8                  |
| Cherrystone | 2 1/4–3             | 2 1/2–3 1/8             | 2 3/8–3 1/4              |
| Medium      | 3–3 1/4             |                         |                          |
| Chowder     | >3 1/4              | >3 1/8                  | >3 1/4                   |

<sup>1</sup> Data from Belding, 1912.

<sup>2</sup> Data from Hadley et al., 1997.

<sup>3</sup> Data from New Jersey dealers.

is "cherrystone," next is "medium," and the largest is "chowder." The term littleneck undoubtedly came into usage to distinguish the short-siphon quahogs from softshell clams which have a long siphon. However, the residents of Marion, Mass., wonder whether the name came from Littleneck Point, a short arm of land jutting into Sippican Harbor, because a large number of quahogs used to be shipped from there.



Figure 32.—A quahog peddler and his peddling cry, New York City; probably drawn in early 1900's (Copyright collection of The New-York Historical Society).

The shape of the quahog does resemble the pit or stone of a cherry, but Glancy (1943) believed the name "cherrystone" may have originated from the fact that Cherrystone, Va., was an early shipping point for this size. The tough meats of the largest quahogs were usually cut into pieces and used in chowders, hence the name. Another common name in the late 1800's was "tea clam," referring to quahogs which were about an inch (25.4 mm) in breadth. The smallest of the littlenecks often were served as an appetizer at an evening meal with 2–3 on a plate with a slice of lemon (Ingersoll, 1887).

In the hotels and restaurants in New York City, the customers' first choice of raw quahogs on the half-shell was littlenecks, then cherrystones. The shucker at a raw bar removed the upper shell of the quahogs with a special knife, cut the two muscles from the lower shell, and presented the quahog meat in the bottom shell (sometimes with lemon juice or

sauce) to customers. The establishments also served quahog (clam) chowder (Anonymous, 1897).

Some saloons served free quahogs to people who purchased drinks. In the early 1890's, the restaurants in New York City were pressuring legislators to ban the practice saloons had of serving free food, including sandwiches and quahogs, to patrons who purchased alcoholic drinks, because it was hurting their business. In response, the New York State legislature passed the Raines Bill, which did ban the practice in 1896, and the sales of Raritan Bay quahogs declined substantially during the only year it remained in effect (MacKenzie, 1992a).

Chowder as a soup originated in New England with the earliest settlers, who put in a pot things they had on hand, including potatoes, onions, milk, and seafood (usually quahogs, cod, or haddock), salt pork, salt, and pepper (Hawkins and Hawkins, 1976). However, Robinson (1981) said, "Originally chowders were made with crackers along with quahog meat, salt pork, milk, and onion, since potatoes did not come into general use until later. The chowder was thickened with crackers soaked in milk, then added to the hot mixture." Credit for creating Manhattan clam chowder is given to a restaurateur on New York's Coney Island boardwalk. He simply added tomatoes and eliminated milk from the chowder (Hawkins and Hawkins, 1976). Chowder parties were also very popular (Plate 9).

#### History of Harvesting Gear and Methods

At least 14 methods or types of gear have been used to harvest quahogs commercially. Some have also been used for recreational harvests. The first four methods described below are most effective during low tides in waters <1 m deep, while the other methods are most commonly used in deeper waters. The low tides advance about 1 h each day, a circumstance to which the fishermen have had to accommodate.

The harvesting methods involve repetitive feeling with feet or hands, raking, or dredging for quahogs usually for 4–6 h a day. After the fisherman has finished digging the quahogs out of the sediments

in an area with his feet, hands, or rake, he hopes the next area he will try just ahead of him will have more quahogs in it than in the area he had just harvested.

All the harvesting gears were developed by fishermen or fishing companies working in concert with blacksmiths. The first hand rakes were made of iron and had thick teeth because this metal was relatively soft. Pulling them through sediments was tiresome. When blacksmiths were able to replace iron with steel they made the teeth thinner for easier raking and the steel teeth lasted much longer. Any new gear developments spread to other fishermen along the coast by word of mouth and by migratory fishermen who harvested with the gear in other states. For many decades, such technology transfers often took many years, but recently they have been made more quickly. In the 1990's, nearly all harvesting methods, from treading through use of hydraulic escalator harvesters, described below, remain in use in some areas in the fishery. The basket rake and the sail dredge are no longer in use.

#### Treading

Treading undoubtedly is the oldest method used to harvest quahogs, but it was not documented until the 1870's (Ingersoll, 1887). In the late 1800's, treading was a common quahog harvesting method around Highlands, N.J., where both women and men treaded in the warm summer months (Kobbe, 1982). The harvesters, usually in knee-to waist-deep water, placed their feet close together and parallel, twisted them as they moved sideways to feel the quahogs, and then gathered them with their hands. They often lifted them up one of their legs with the opposite foot and then took them by hand. A harvester could collect as many as 4 bu in 2 h (MacKenzie, 1992a). In small areas, treaders have found that a mat of sea lettuce, *Ulva lactuca*, forces the quahogs to emerge from sediments, so they can be collected more easily (Jenks<sup>6</sup>). Treading continues as a harvest method in such areas as Prince Edward Island (Fig. 33); Barnegat Bay, N.J.; Chincoteague Bay, Va. (Fig. 34); Cove and Bogue Sounds, N.C.; and eastern Mexico. Fishermen





Plate 9.— Chowder party at Fire Island, Long Island, N.Y. (ca. 1873).

nowadays wear sections of tire inner tubes or neoprene booties on their feet while treading.

#### Hand Picking

Harvesting quahogs by hand is practiced in Canada's Maritime Provinces, especially on Prince Edward Island (Fig. 35), and also in Virginia (Fig. 36), North Carolina, and South Carolina. Using protective rubber gloves, fishermen get on their hands and knees in water up to their knees and sweep their hands through firm muddy bottoms feeling for quahogs. They place them in a bushel box floating in an inner tube. When successful, fisher-

men can collect up to 2.5 bu of quahogs during a low tide.

#### Short Raking

The short rake, also called a "scratch rake," probably was the earliest gear used to collect quahogs. The rakes used in the early 1900's had the shape of a bird's claw with about 11 teeth and a 1.5-m handle (Fig. 37). In recent years, the front edge of the teeth forms nearly a straight line. Fishermen use the short rake by wading and pulling the rake through the sediments while also forcing it downward (Fig. 38, 39). They commonly harvest at a rate of 2–3 quahogs for

every three passes over the bottom and, when successful, can harvest 2–4 bu of quahogs during a low tide. Short rakers often find three quahogs of different sizes together, touching one another, for example, a cherrystone, a littleneck, and a seed. The cherrystone supposedly set and somehow avoided predators. After it grew some, a juvenile quahog set next to it and predators could not find it, and, finally, the third juvenile set between them where it too was hidden from predators.

#### "Signing"

"Signing" is most commonly practiced on intertidal flats within the bays



Figure 33.—Harvesting quahogs with feet and hands, Prince Edward Island, 1998. Photograph by A. Morrison. This method was likely used for harvesting quahogs by native American Indians during pre-historic times (Ingersoll, 1887).

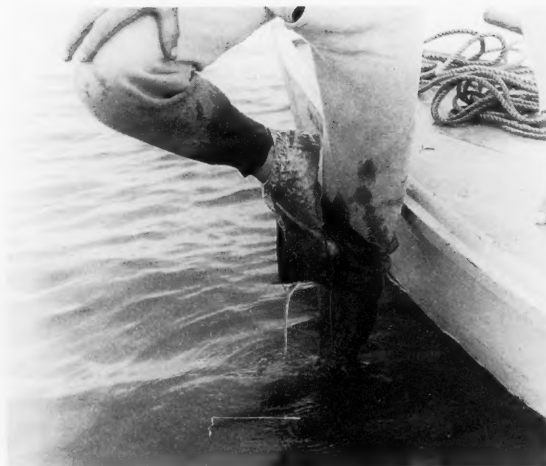


Figure 34.—Harvesting quahogs with feet, Chincoteague, Va., 1948. From A. Aubrey Bodine Collection. Courtesy of The Mariners' Museum, Newport News, Va.

and estuaries of coastal Virginia and North Carolina. Fishermen look for the quahog's siphon holes and fecal pellets and then use a pick (Fig. 40) or rake for collection. Each harvester can collect 2–4 bu of quahogs during a low tide.

#### Pea Digger

Fishermen in North Carolina and South Carolina use pea diggers, 4-tined rakes (Fig. 41), to harvest quahogs on intertidal flats which have considerable quantities of shells or stones. They dig in soft areas around the objects to find the quahogs.

#### Hand TONGING

Hand tongs were originally devised for harvesting oysters, and that application was first recorded in Maryland in 1701 (Witty and Johnson, 1988) and in Nova Scotia in 1721 (de Charlevoix, 1744). Quahog hand tongs differ from oyster hand tongs slightly in having more steeply angled teeth, allowing penetration into sediments to grasp quahogs, and the teeth are spaced about 35 mm apart instead of 50 mm apart as in oyster tongs. They require greater effort from the fisherman than oyster tongs (Fig. 42). Tongs continue to be used in many

localities from the Canadian Maritimes to Florida (Fig. 43, 44); their use is limited to depths less than 3.7 m.

#### Patent Tongs

Patent tongs were first used in Virginia for harvesting quahogs, probably in the early 1900's. The tongs were dropped to the bottom open and they closed as they were lifted. By the 1920's, the models were large (about 1.3 m × 1.3 m) and heavy (55 kg or more), and were powered by a hand-winch requiring two men for effective operation. Patent tonging was most often done in slowly moving waters; one man worked the winch while another handled the tongs and culled. A crew required 3–5 min to complete a "lick" (a complete drop and retrieval of the tongs).

During the late 1920's and early 1930's, fishermen developed engine-powered tongs to replace hand-operated patent tongs. These were run by an air-cooled motor of 4–6 hp, or by a power take-off on the boat's engine. By the 1970's, patent tongs had a hydraulic piston-closing device which made them more efficient (Castagna and Haven, 1972). Their operational speed was increased to about 3 licks/min in sandy bottoms and

2 licks/min in muddy bottoms where the quahogs have to be washed by raising and lowering the tongs in the water.

Although powered patent tongs remain large and heavy (Fig. 45), most boats now operate with just one person due to their mechanical efficiency. Boats with two patent tongs have one on each side and two people. When currents run too fast, fishermen drag a weight along the bottom to slow the boat speed.

#### Seed Forks

The seed fork is similar to a short-handled manure fork, but the teeth are closer together (31–34 mm apart) (Fig. 46). This fork works well in soft substrates (Ashley<sup>20</sup>). The quahoger pushes it into the substrate at a slight angle and moves the handle up and down as the fork is moved forward just below the surface. He lifts the rake through the substrate and then up to his waist and removes the quahogs off its teeth.

#### Bull Rakes

The long-handled bull rake originated in Raritan Bay, N.Y. and N.J., in about

<sup>20</sup>Ashley, E. Owner, Ashley Seafood, McClellanville, South Carolina. Personal commun., 1998.



Figure 35.—Harvesting quahogs by feeling in muddy sediments, Prince Edward Island, 1998. Photograph by A. Morrison.

1863 (Leonard, 1923) (Fig. 47). It has also been called a "Keyport" rake and a "Shinnecock" rake. The first rakes were about 75 cm wide with about 30 curved metal teeth, and they were used with wooden handles. Before their development, Raritan Bay fishermen knew little about quahog abundances in bottoms beyond wading depths. Bull rakes were used consistently thereafter in the bay, but they did not become the principal tool for most quahoggers until the early 1960's in Great South Bay, N.Y. (Anonymous, 1985), until 1971 in Narragansett Bay, R.I. (Pratt, 1988), and until the mid 1970's in North Carolina. In Florida's recent Indian River Lagoon quahog fishery, the bull rake has been and remains the principal harvesting gear.

#### *Bull Rake Construction*

The first bull rakes were made by blacksmiths in Keyport, N.J. The following description of how the rakes and handles were made is from MacKenzie (1992a:150–152) (Fig. 48):

"A blacksmith made the 28 teeth of a rake from 10/30 carbon-steel rods 6 m long and 9 mm in diameter. The first step was to cut the rods to a length of a tooth, 38 centimeters. The teeth were heated in a fire about 12 cm from their ends and made oval-shaped by hitting them with a hammer. After being cooled and tempered by a dip in oil, they were sharpened on a grinding wheel; sharpening 28 teeth took half an hour. The next step was to heat the entire length of each tooth and bend them over a curved form. The attachment



Figure 36.—Harvesting quahogs by feeling with hands, Chincoteague, Va., 1948. From A. Aubrey Bodine collection. Courtesy of the Mariners' Museum, Newport News, Va.

end of each tooth had to be heated and hammered to make it thicker, for a strong weld on the tooth bar.

"The tooth bar was made of 25-by-12.5-mm steel. The places where the teeth were to be welded on it were marked with chalk, and the bar was clamped onto the anvil. Next, the 2 'crabs' (sharply curled teeth at each end of the rake to hold in the quahogs) were welded onto the end teeth, and then each tooth was welded onto the bar spaced a little less than an inch apart. The shank of the rake was welded on last. A blacksmith cut and made all the pieces for 2 rakes in a morning and welded them together and lined up the teeth in an afternoon.

"The rake handles, constructed by different tradesmen, were made from longleaf yellow pine, because it contains much pitch and remains fairly moist. Dry species of wood snapped easily when being used. The handles were made from logs as long as 12 meters. A log as large as 30 cm on a side could yield eight handles. The logs were cut into 5 cm-by-5 cm square pieces with a circular

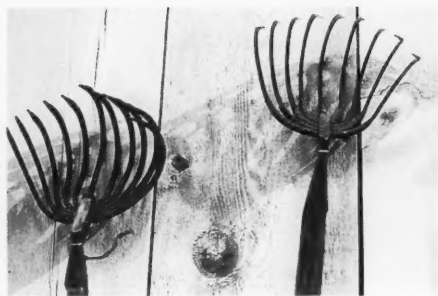


Figure 37.—Short rakes used in the early part of this century had the shape of an avian's claw in New Jersey and other areas. Photograph by C. L. MacKenzie, Jr.

Figure 38.—Harvesting quahogs with a short rake, Chincoteague, Va., 1948. From A. Aubrey Bodine Collection. Courtesy of The Mariner's Museum Newport News, Va.

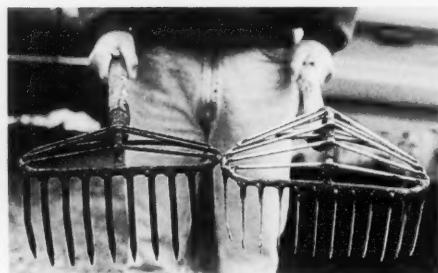


Figure 39.—This style of short rake (at right) is used to harvest quahogs in North Carolina. The model at left was made of iron, while the model with thinner teeth at right was made of steel. Photograph by C. L. MacKenzie, Jr.



saw. The corners were planed by repeatedly going along the full length of the handle until it was round. Most handles were about 10 m long. Each handle also required 3 splices, ranging in length from 60 cm to 2.4 meters. Fishermen had found the angle between their rakes and the bottom had to be about 45 degrees. Since the fishermen raked at various depths, they needed the splices to adjust their handle lengths, the splices being held onto the handles with metal rings. If fishermen cared for their rake handles,

they lasted 5–6 yrs. Whenever a rake was heavy and nearly full of quahogs, a fisherman had to bring the handle straight up in the air as far as he could before the rake reached the surface, or otherwise there would be too much curve in the handle and it would snap."

Since about 1960, fishermen and blacksmiths have made progressive changes in the design of bull rakes. The latest designs were based on the shape of the basket rake (Fig. 49). Some fishermen call the new design a "bubble"

rake, owing to its shape (Fig. 50). The rake head usually is about 65 cm wide, but some fishermen have models as wide as 1.5 m for harvesting in soft mud-like sediments. The rake is used with an aluminum handle that has more flexibility, less weight, and is stronger than wooden handles (Fig. 51, 52, 53). The handle comes in 3.7-m sections. Its handle length is adjusted by moving the sections inside one another, their positions being held by hose clamps (Fig. 54). The cross heads which the diggers hold are



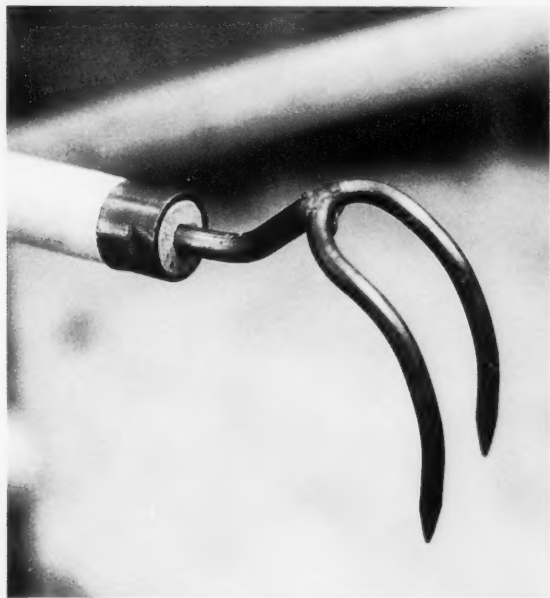


Figure 40.—Left: A pick (gaff-hook) used for harvesting quahogs on intertidal flats and shallow water at low tide on the eastern shore of Virginia. Photograph by C. L. MacKenzie, Jr. Right: "Signing" or using a pick to harvest quahogs on eastern shore of Virginia. From A. Aubrey Bodine Collection, courtesy of The Mariner's Museum, Newport News, Va.

36 cm wide. Those used in Raritan Bay are straight, whereas Rhode Islanders use slightly bent cross heads that are more comfortable to hold (Fig. 55). Bubble rakes far out-harvest the original Keyport bull rakes; one fisherman (Harry<sup>21</sup>) estimates it harvests about twice as many quahogs as a Keyport rake would. In the 1990's, the bubble rake was redesigned, with a basket made about twice as deep but not higher, to hold more quahogs. It is referred to as a "suitcase" rake (Fig. 56). Usually made of stainless steel, bubble rakes and suitcase rakes last for many years. When using hand rakes, fishermen say, "The more you put into the upper end of the handle, the more you get from the other end."

#### Sail Dredge

The sail dredge was developed in the late 1860's-early 1870's to harvest

quahogs from sailing vessels in Raritan Bay. A modification of the bull rake, it remained in use until the early 1970's. The fishermen termed it a dredge (Fig. 57), but it was a rake similar in design to the bull rake and was about four teeth wider. It was constructed with a stout wooden handle about 1.5 m long that allowed for towing with a rope under sail from a catboat, sloop, or small schooner. Catboats towed 2-3 dredges, sloops towed 4 dredges, and schooners towed up to 6 dredges. Most catboats and sloops had a crew of two, with each man hauling two dredges, one at a time, by hand (Fig. 58), whereas schooners had a crew of three when six dredges were used. The ropes pulling the dredges were from 14 to 23 m long, the ratio of rope length to water depth, 5-7 m, being about 3:1. The boat's centerboard was raised and the mainsail and the jib were set so the boat would sail almost sideways. The sail dredgers worked only in mud-like bottoms, as the dredges would not pull through hard sand bottoms (MacKenzie, 1992a).

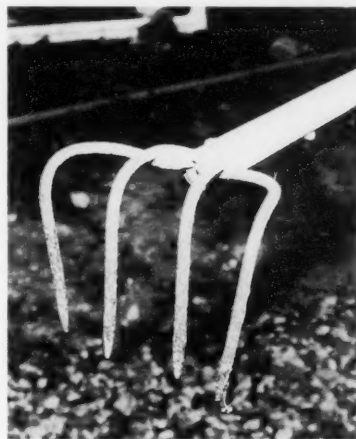


Figure 41.—A pea digger used for harvesting quahogs in shelly and rocky flats in North Carolina. Photograph by C. L. MacKenzie, Jr.

#### Basket Rake

The basket rake (Fig. 49) was used on Cape Cod and the offshore island of Martha's Vineyard from at least the early

<sup>21</sup>Harry, J. Relay quahog fisherman, Raritan Bay and Barnegat Bay, New Jersey, and President of the New Jersey clam relayers. Personal commun., 1999.

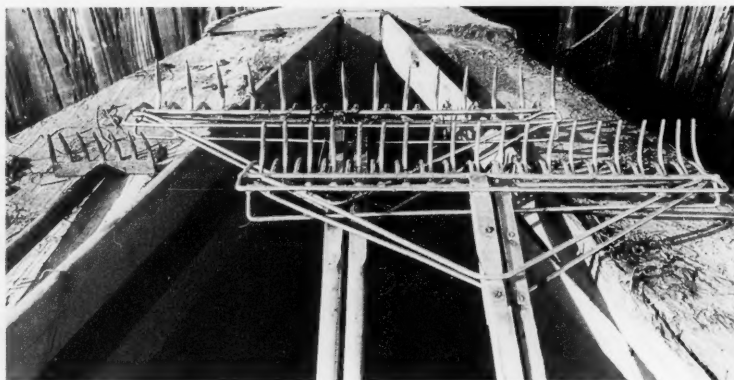


Figure 42.—At left is quahog short rake; at center are oyster tongs; and at right are quahog tongs, Prince Edward Island, Canada. Photograph by A. Morrison.



Figure 43.—Fisherman with his quahog harvest obtained by using tongs, on converted sloop, Great South Bay, N.Y., 1930's (from Glancy, 1943).

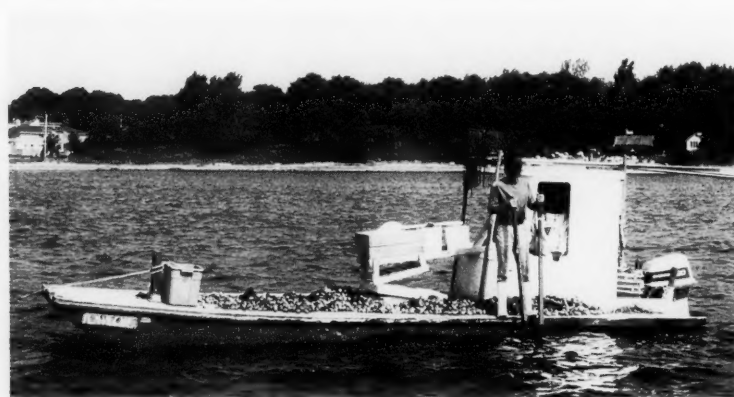


Figure 44.—Tonging for quahogs, Raritan Bay, N.Y., 1998. Photograph by C. L. MacKenzie, Jr.

1900's (Belding, 1912) into the 1950's. To harvest with a basket rake, the fisherman anchored his boat, usually a catboat, in water 1–2 m deep, put the rake out to almost the full length of its wooden handle, put the handle against his shoulder, extended his arms full length down the handle and then pulled the handle in a jerking motion using both arms toward him as he pressed down on its upper side; the pivot point was his shoulder. This forced the rake through the sediments and in doing so the quahogs in its path slid up its teeth and collected in its basket.

### Rocking-Chair Dredge

The rocking-chair (Fall River) dredge (Fig. 59) was developed for use in Narragansett Bay in 1945–46, but its use spread from Massachusetts to Connecticut and Raritan Bay by 1946. The dredge consists of a tooth bar about 60 cm wide with teeth about 18 cm long, a metal sheet measuring about 40 × 60 cm placed on top of the dredge and angled slightly from vertical to hold the dredge down while being towed, and a chain bag that holds about 8 bu. The dredges are towed by wire cable from motor boats in water depths from 3.5 to 7.5 m.

### Hydraulic Dredge

The hydraulic dredge (Fig. 60) was first used for quahog harvesting in Connecticut, where it replaced the rocking-chair dredge, in 1958. A water pump mounted on the deck of the boat delivers water under high-pressure through jets mounted on a manifold in front of the dredge bar. The water jetted into the sand bottom loosens the sediments and associated quahogs, and the quahogs are collected as the dredge bar passes several centimeters under the sediment surface. Similar dredges had been developed for the ocean surfclam fishery in the mid-1940's (Parker, 1971).

### Hydraulic Escalator Harvester

The escalator harvester dredge was developed in Maryland for harvesting soft-shell clams in 1954. It was modified to harvest quahogs in bays on Long Island, N.Y., a year or two later (MacPhail, 1961; Godcharles, 1971; Haven et al., 1979). Strong water jets wash the quahogs out

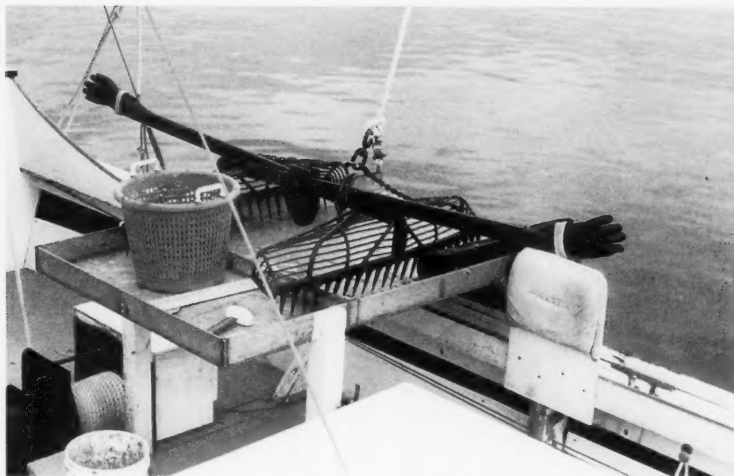


Figure 45.—Patent tongs used for harvesting quahogs in Virginia, Gwynn's Island, 1995. Photograph by C. L. MacKenzie, Jr.

of sediments onto a metal mesh belt that carries them to the surface (Fig. 61–65). Workers pick the quahogs off the belt and put them in baskets by size category. Escalator harvesters also have been used for harvesting quahogs in Maryland, North Carolina, for deep-water quahog resources in St. Joseph Bay, Florida, and, since about 1973, in South Carolina by special permit on public beds that are restricted areas for depuration and on private shellfish beds. On peak days, each South Carolina rig can harvest almost three hundred 250-count bags of quahogs (SCWMD, 1974, 1980, 1986, 1990; Ashley<sup>20</sup>). Although now illegal in most other areas of Florida, an early type of hydraulic escalator dredge was used extensively in the exploitation of the Marco Island quahog fishery in the Ten Thousand Islands area (Schroeder, 1924; Godcharles and Jaap, 1973).

### Kicking

In North Carolina, quahog "kicking" is effected by mechanically washing quahogs out of the bottom by the propeller of a harvesting boat, 6–9 m long, as it moves forward (Guthrie and Lewis, 1982). A heavy-chained trawl net, 3.7–6.0 m wide, is towed behind the boat to collect the quahogs from the sediment surface (Fig. 66, 67) and is lifted periodically for

emptying. This fishery, first developed in about 1940, is popular with fishermen because it does not require elaborate equipment and the boats are easily equipped for the operation.

Kicking is restricted to <3 m depths. The fisherman positions his boat propeller about 30–35 cm above the bottom so the downward prop wash ejects the quahogs from the sediment. Boats with drafts up to 2 m can harvest quahogs in water 3 m deep, while boats with shallower drafts and a tunnel for the propeller shaft can harvest at depths of 30–60 centimeters. Weight in the form of barrels of water, bags of quahogs, or flooded stern compartments is added to the stern to achieve the optimum propeller angle and depth above the bottom. Fishermen tow doors that measure 1 × 2 m off each side of their boats to maintain a slow towing speed.

Two major innovations in kicking gear have been implemented since 1968. Deflector plates have been attached to the rudder to deflect the propwash downward, and a steel cage has replaced the tailbag previously used. The cage is a 60 × 60 cm rectangular box made of 9.5 mm steel rods spaced 22 mm apart and with sled runners attached to the bottom. A latched rear door can be released to dump the catch onto the boat's culling tray.



Figure 46.—Seed fork used to gather quahogs from soft substrates in South Carolina. Photograph by V. G. Burrell, Jr.

### Scuba picking

Since the early 1970's, scuba divers have harvested quahogs commercially in Narragansett Bay, R.I. (Fig. 68), and in the Indian River Lagoon, Fla. The equipment for some divers includes a rake, usually a 3-prong garden rake with a handle about 20 cm long, and a bag tied around their waist to hold the catch. While lying on the bottom, the diver reaches ahead and loosens the bottom sediment with the rake, and he then feels for any uncovered quahogs which he places in the bag. Other divers harvest without using a rake. They find quahogs by rapidly fanning one of their hands over the bottom to scour away some sand. The quahogs that become visible are gathered.

The Rhode Island divers remain in the water for 3–4 hr a day, each dive lasting about 30 min.

### Sorters

In recent years, companies have sorted their quahogs by size on mechanical tables set on their boats or in their shore-based shops (Fig. 69). The tables are made of steel and can sort quahogs into 4–5 size categories. They have two rollers spaced closely together on their tops; each roller is about 1 m long, they are spaced closer near the beginning of the rollers than at their opposite end, they are tilted, and they spin. Crews stack quahogs onto the upper ends of the rollers (Fig. 70) and, as the quahogs slide toward their opposite ends, they fall between them into chutes leading to collection bags: Littlenecks drop first, topnecks next, cherrystones next, and finally the chowders.

Hand sorters are shallow boxes about 45 cm square with a row of parallel metal bars spaced to retain legal-sized quahogs and allow seed to fall between them (Fig. 71). The use of hand sorters has spared the fishermen the task of measuring every quahog that is close to the minimum legal size.

Part II of this article, which will appear in the next issue of the *Marine Fisheries Review*, will summarize the



Figure 47.—Style of bull rakes (leaning on shed) used in late 1800's, Raritan Bay, N.J. (from photographic archives of James J. Howard Marine Sciences Laboratory).

history of the industry in specific Canadian provinces and U.S. and Mexican states, and will discuss quahog enhancement programs



Figure 48.—Blacksmith making the style of bull rake used from 1800's to 1970's, Keyport, N.J., 1950 (gift from G. Porter, Keyport, N.J.).

### Acknowledgments

This paper has benefitted from the contributions of many people. John Harvey

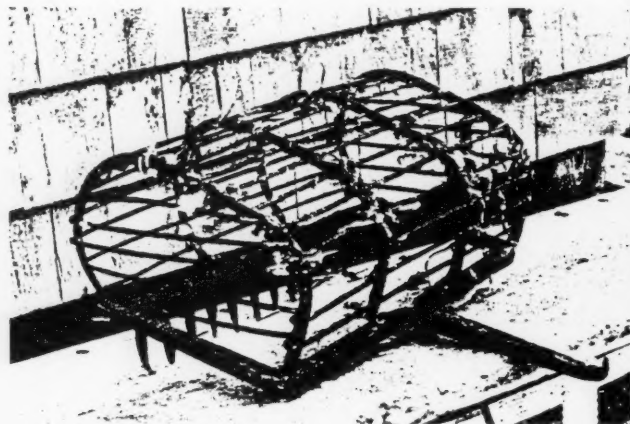


Figure 49.—Basket rake used in Massachusetts from at least the early 1900's into the 1950's (from Belding, 1912). The modern style bull (bubble) rake was copied after this design.



Figure 50.—A bull (bubble) rake with short handle for harvesting quahogs from beds on which fishermen can wade, Pleasant Bay, Ma., 1998. Photograph by C. L. MacKenzie, Jr.



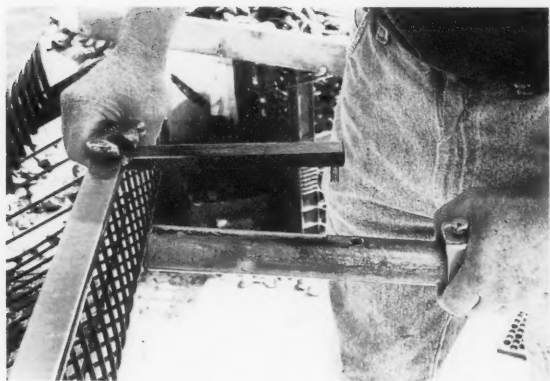


Figure 51.— Bull (bubble) rake about to be attached to an aluminum handle, Great Salt Pond, R.I., 1998. Photograph by C. L. MacKenzie, Jr.



Figure 52.—Fastening a bull (bubble) rake onto an aluminum handle, Great Salt Pond, R.I., 1998. Photograph by C. L. MacKenzie, Jr.

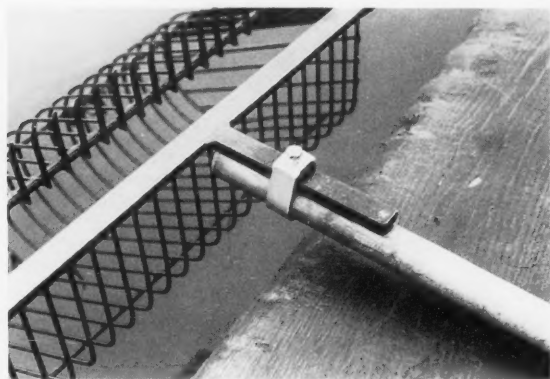


Figure 53.— A bull (bubble) rake attached onto an aluminum handle, Great Salt Pond, R.I., 1998. Photograph by C. L. MacKenzie, Jr.

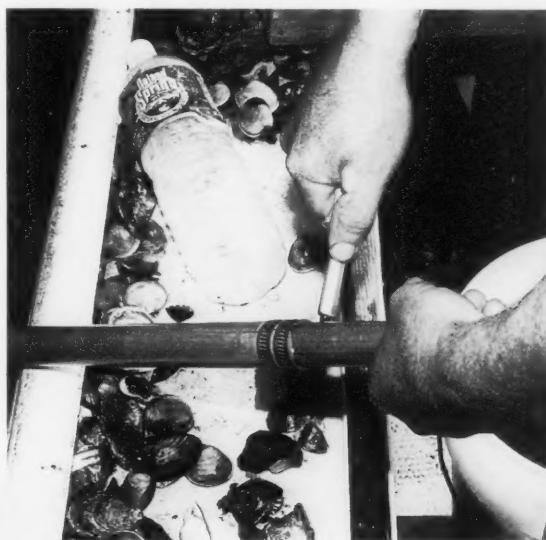


Figure 54.—Lengthening the rake handle as the tide rises, Great Salt Pond, R.I., 1998. Photograph by C. L. MacKenzie, Jr.



Figure 55.—The cross-bar (cross-head) of a bull (bubble) rake in Rhode Island is bent to be more comfortable while raking. Note styrofoam float on handle to prevent it from sinking below the water surface. Photograph by C. L. MacKenzie, Jr.

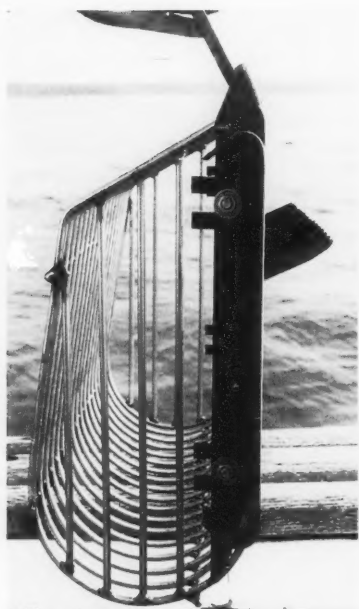


Figure 56.—Sideview of "suitcase" quahog rake. Photograph by C. L. MacKenzie, Jr.



Figure 57.—Fisherman with sail "dredge" on sloop in Raritan Bay, N.J., 1940's (source of photograph: W. Thompson).

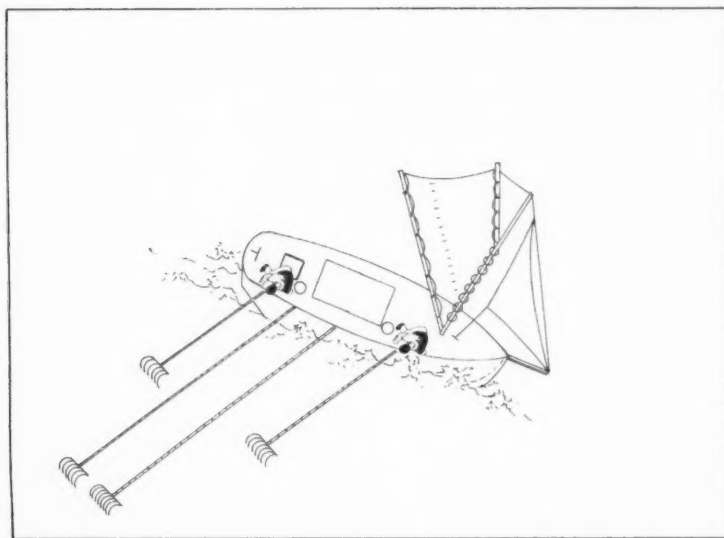


Figure 58.—Two crewmen on sloop haul in the two outer sail "dredges" together, empty the quahogs on deck, toss the rakes back, and then repeat the cycle with the two inner rakes, Raritan Bay, N.J.

in Rhode Island, Larry Williams in Connecticut, Dave Relyea and Joe Zatilla in Oyster Bay, N.Y., Craig Strong in Great South Bay, N.Y., and John Chadwick in Barnegat Bay informed us about the quahog fisheries in their localities while taking us out on their boats to observe their harvesting of quahogs. Most of the people who contributed verbal and written information are listed in the personal communications; others not listed are Indian River Lagoon quahogers Peter Barile, Artie Feldman, Nick Hill, Bill Leeming, and Doug Telgen. April Valiere, State of Rhode Island Coastal Fisheries Laboratory, Rhode Island Department of Environmental Management, Wakefield, R. I., supplied historical landings of Quahogs in Rhode Island. Randy Clark and Dave Whittaker, Massachusetts Division of Marine Fisheries, Pocasset, provided material about quahog harvesting in Massachusetts. Dexter S. Haven, retired shellfish biologist, Virginia Institute of Marine Science, Gloucester Point, supplied printed materials about the use of wampum by the Powhatan Indians in Virginia. Martha Norris, Fisheries Dependent Monitoring section, Florida Marine Research Institute, provided landings data and insights into the collection and availability of those data. Barbara O'Bannon, NMFS Fisheries Statistics and Economics Division, Silver Spring, MD, provided landings data from several states. Christopher Dungan provided materials on bivalve diseases. Ron Dugas, Louisiana Department of Wildlife and Fisheries, sent materials regarding southern quahogs in Louisiana. Jo-Ann McLean, Nassau County Garvies Point Museum and Preserve, Glen Cove, N.Y., provided several references on wampum and also reviewed the wampum section. Walter Blogoslawski, NMFS Laboratory, Milford, CT, provided useful comments on an earlier draft. Willis L. Hobart, Chief, NMFS Scientific Publications Office, Seattle, WA, suggested we write this paper.

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Figure 59.—A rocking chair dredge. Photograph by C. L. MacKenzie, Jr.

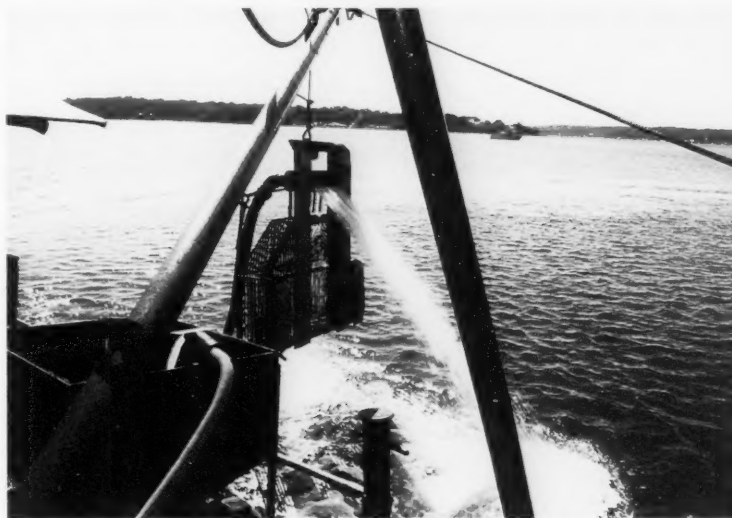


Figure 60.—Hydraulic dredge with water coming from jets as it is lifted out of water. Oyster Bay, N.Y. Photograph by C. L. MacKenzie, Jr.

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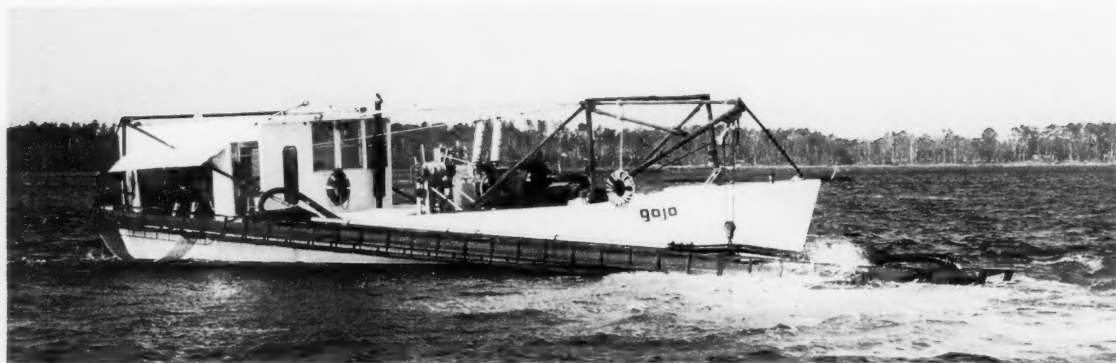


Figure 61.—Hydraulic escalator dredge for quahogs attached to boat. Anterior end has been raised to water surface (State of North Carolina). Photograph by C. L. MacKenzie, Jr.



Figure 62.—Deck of Maryland quahog boat using hydraulic escalator harvester. Pump and suction head (raised) are at right. Escalator dredge (raised) is at left. Hose runs from pump to dredge. Photograph by M. Homer.

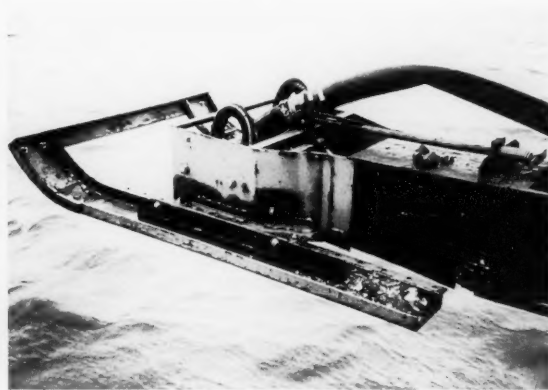


Figure 63.—Front end of hydraulic escalator dredge showing skids (State of Maryland). Photograph by M. Homer.

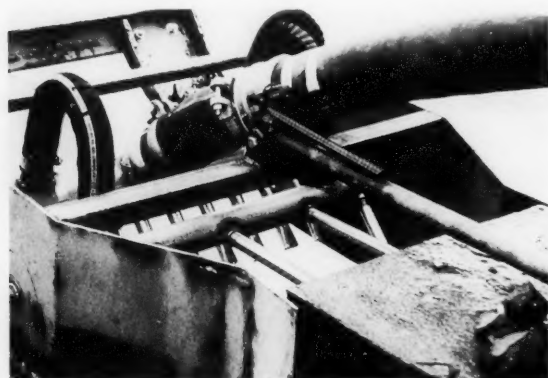


Figure 64.—Front end of hydraulic escalator dredge showing hose and water jets (State of Maryland). Photograph by M. Homer.



Figure 65.—Posterior end of hydraulic escalator dredge showing fisherman picking quahogs from metal mesh screen conveyor (State of Maryland). Photograph by M. Homer.



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Figure 66. — Boat (left) rigged for "kicking" quahogs; large doors are used to slow speed of boat, Carteret County, N.C., 1998. Photograph by C. L. MacKenzie, Jr.



Figure 67. — Cage and net used to gather quahogs rest on box at stern of a "kicking" boat. When the box is filled with water, its weight sinks the stern and doors on the sides slow the speed of the boat while the boat is "kicking" quahogs out of the bottom, Carteret County, N.C. Photograph by C. L. MacKenzie, Jr.

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Figure 68.—Crew of SCUBA divers getting ready to enter water to harvest quahogs, Great Salt Pond, R.I., 1998. Photograph by C. L. MacKenzie, Jr.

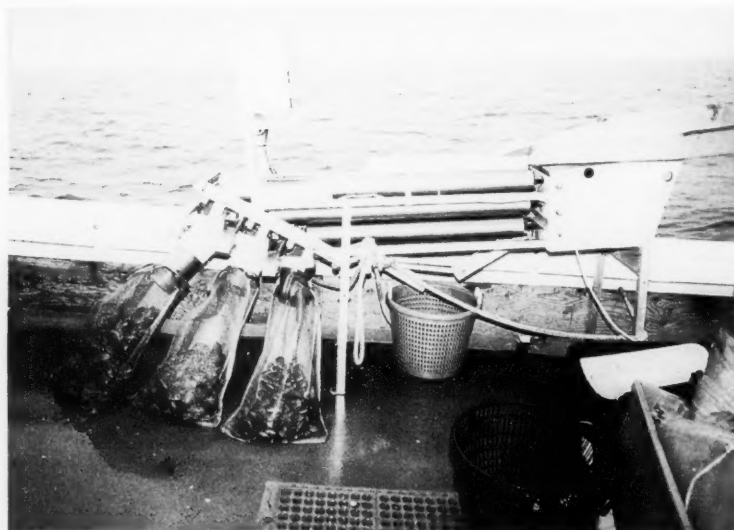


Figure 69.—Mechanical sorter and bags that collect quahogs after they have been sorted by size and counted on hydraulic dredge boat, Milford, Ct., 1998. Photograph by C. L. MacKenzie, Jr.

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Figure 70.—Feeding northern quahogs into mechanical sorter. Photograph by C. L. MacKenzie, Jr.



Figure 71.—Hand sorter retains legal-size quahogs while seed passes through when shaken overboard. Photograph by C. L. MacKenzie, Jr.

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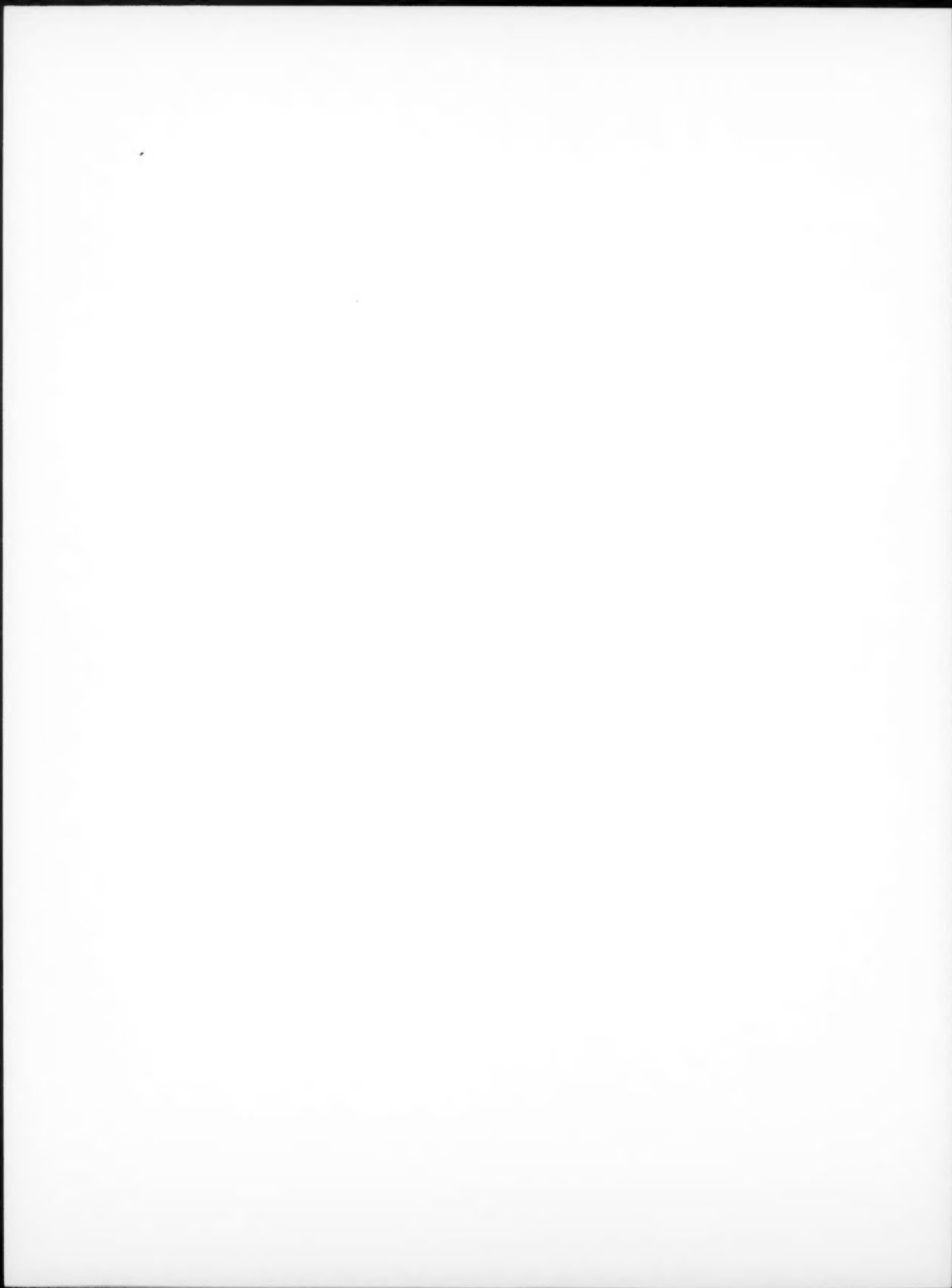
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The *Marine Fisheries Review* publishes review articles, original research reports, significant progress reports, technical notes, and news articles on fisheries science, engineering, and economics, commercial and recreational fisheries, marine mammal studies, aquaculture, and U.S. and foreign fisheries developments. Emphasis, however, is on in-depth review articles and practical or applied aspects of marine fisheries rather than pure research.

Preferred paper length ranges from 4 to 12 printed pages (about 10-40 manuscript pages), although shorter and longer papers are sometimes accepted. Papers are normally printed within 4-6 months of acceptance. Publication is hastened when manuscripts conform to the following recommended guidelines.

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Submission of a manuscript to *Marine Fisheries Review* implies that the manuscript is the author's own work, has not been submitted for publication elsewhere, and is ready for publication as submitted. Commerce Department personnel should submit papers under a completed NOAA Form 25-700.

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Keep titles, heading, subheadings, and the abstract short and clear. Abstracts should be short (one-half page or less) and

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Tables and footnotes should be typed separately and double-spaced. Tables should be numbered and referenced in text. Table headings and format should be consistent; do not use vertical rules.

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